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CALENDAR, 1882–83.

Tuesday, September 19.	**Current Academic Year Began.**
Tuesday, September 26.	**Instructions Resumed.**
Tuesday, October 24.	**Mr. Harris's Lectures on New Testament Greek Began. (See p. 13).**
Saturday, November 4.	**M. Rabillon's Lectures on French Literature Began. (See p. 14).**
Friday, November 10.	**Dr. W. H. Carpenter's Lectures on The Eddas, etc., Began. (See p. 13).**
Thursday, November 30.	**Thanksgiving Day.**
Friday, December 1.	**Meeting of Philological Association, 12 M.**
Tuesday, December 5.	**Dr. R. T. Ely's Lectures on French and German Socialism Begin. (See p. 14).**
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Tuesday, December 12.	**Meeting of Metaphysical Club, 8 P. M.**
Friday, December 15.	**Meeting of Historical and Political Science Association, 8 P. M.**
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SCIENTIFIC NOTES

On the work of members of this University in Mathematics, Physics, Chemistry, Biology, Ancient and Modern Languages, History, Political Science, Psychology, Ethics, and Logic.

Mathematics.

On Crocchi's Theorem, by J. J. SYLVESTER.

[Abstract of a paper read before the University Mathematical Society, October 18, 1882].

In Battaglini's Journal for July, 1880, Signor Crocchi has given a theorem which may be stated in the following terms. If s_i, σ_i, h_i denote respectively the sum of the elementary combinations, of the powers, and of the homogenous products each of the ith order of any number of elements, then h_i is the same function of $\sigma_1, \bar\sigma_2, \sigma_3, \bar\sigma_4, \ldots$ that s_i is of $\sigma_1, \sigma_2, \sigma_3, \sigma_4, \ldots$

Signor Crocchi's proof is very elegant but a little circuitous. An instantaneous proof may be derived from the relation of reciprocity which connects s and h, viz., that if $h_i = f(s_1, s_2, \ldots s_i)$ then $s_i = f(h_1, h_2, \ldots h_i)$, which is an immediate deduction from the well known fact that

$$(1+s_1y+s_2y^2+s_3y^3+\ldots)(1-h_1y+h_2y^2-h_3y^3+\ldots)=1.$$

For from this relation spring the equations

$$s_1-h_1=0, \quad s_2-h_1s_1+h_2=0, \quad s_3-h_1s_2+h_2\sigma_1-h_3=0\ldots$$

which equations continue unaltered when the letters s and h are interchanged; for when such interchange takes place, the functions equated to zero of an even rank remain unaltered and those of an odd rank merely change their sign.

Returning to the immediate object in view, if $a, b, c, \ldots$ are the elements subject to the s, h, σ symbols, we may write

$$\Sigma \log. (1+ay) = \log. (1+s_1y+s_2y^2+s_3y^3+s_4y^4+\ldots)$$

$$\text{or,} \quad \Sigma \log. (1-ay) = -\log. (1+h_1y+h_2y^2+h_3y^3+h_4y^4+\ldots)$$

The first equation by differentiation performed in each side gives

$$\sigma_1-\sigma_2y+\sigma_3y^2-\sigma_4y^3\ldots=\frac{s_1+2s_2y+3s_3y^2+4s_4y^3+\ldots}{1+s_1y+s_2y^2+s_3y^3+\ldots}$$

and similarly the second equation gives

$$\sigma_1+\sigma_2y+\sigma_3y^2+\sigma_4y^3\ldots=\frac{h_1+2h_2y+3h_3y^2+4h_4y^3+\ldots}{1+h_1y+h_2y^2+h_3y^3+\ldots}$$

i. e.,

$$(\sigma_1-\sigma_2y+\sigma_3y^2\ldots)(1+s_1y+s_2y^2\ldots)=s_1+2s_2y+3s_3y^2\ldots$$

and

$$(\sigma+\sigma_2y+\sigma_3y^2\ldots)(1+h_1y+h_2y^2\ldots)=h_1+2h_2y+3h_3y^2\ldots$$

By comparison of coefficients of the powers of y, the first of these two equations affords the means of finding any σ in terms of the s quantities, and the second of these any σ in terms of the h quantities. But if we change s into h and $\sigma_2, \sigma_4, \ldots$ into $-\sigma_2, -\sigma_4, \ldots$ the first equation becomes the second. Hence if

$$s=f(\sigma_1, \sigma_2, \sigma_3, \sigma_4, \ldots)$$

$$h=f(\sigma_1, \bar\sigma_2, \sigma_3, \bar\sigma_4, \ldots) \qquad \text{Q. E. D.}$$

It is not without interest to set out the reciprocity of the 6 relations which exist between s, σ, h. The synoptical scheme of such reciprocity may be exhibited symbolically as follows:

$$h/s=s/h, \qquad h/\sigma=s/\pm\sigma, \qquad \sigma/h=\pm\sigma/s.$$

As an illustration of the second of these symbolic equalities take

$$s_3=\frac{\sigma_1^3-3\sigma_1\sigma_2+2\sigma_3}{6} \qquad s_4=\frac{\sigma_1^4-6\sigma_1^2\sigma_2+8\sigma_1\sigma_3+3\sigma_2^2-6\sigma_4}{24}$$

the corresponding equations are

$$h_3=\frac{\sigma_1^3+3\sigma_1\sigma_2+2\sigma_3}{6} \qquad h_4=\frac{\sigma_1^4+6\sigma_1^2\sigma_2+8\sigma_1\sigma_3+3\sigma_2^2+6\sigma_4}{24}$$

and it is worthy of observation that the sum of the numerical coefficients is always (as in the above examples) zero for the function of the σ quantities which give an s of any order, and unity for the function of the same which expresses any h.*

Frequent occasion presents itself (especially in the theory of numbers) for expressing any s in terms of σ's, but probably up to the time when Signor Crocchi wrote on the subject there had never been any occasion to express h in terms of the σ's: for had such occasion ever arisen it seems almost impossible that the relation between the two corresponding sets of formulæ could have escaped observation.

In some recent researches, however, of the writer of this note on the irreducible semi-invariants of a quantic of an unlimited order, it becomes indispensable to convert homogeneous products into sums of powers, and Crocchi's theorem comes into play. (See sec. 4 of Article on Subinvariants, *Am. Math. Jour., Vol. V, part* 2, not yet published).

The relation $\sigma/h=\pm\sigma/s$ is interesting under the point of view that virtually it contains an example of a sort of *invariance* of form which may possibly contain within itself the germ of an important theory. It informs us that if in the function of h's which expresses any σ in lieu of each h, the function of s quantities to which it is equal be substituted, the form of the σ function will remain unchanged, except that when the order of the σ is an even number, its algebraical sign is reversed. Thus *ex. gr.* $\sigma_3=h_1^3-3h_1h_2+3h_3$, $h_1=s_1$, $h_2=s_1^2-s_2$, $h_3=s_1^3-2s_1s_2+s_3$. Consequently if we write $\phi=x^3-3xy+3z$, and for y and z substitute x^2-y, $x^3-2xy+z$, respectively, the value of ϕ remains unaltered. So in like manner if we write $\phi=x^4-4x^2y+4xz+2y^2-4t$ and substitute for y, z, t; x^2-y, $x^3-2xy+z$, $x^4-3x^2y+2xz+y^2-t$, respectively, no change ensues in ϕ except that it undergoes a change of sign.

So in general the σ functions with even and those with odd subindices may be regarded as the analogues of symmetrical and skew-invariants, respectively.

On Certain Successions of Integers that cannot be Indefinitely Continued, by J. J. SYLVESTER.

[Abstract of a paper read before the University Mathematical Society, October 18, 1882].

A succession of decreasing integers we know cannot be indefinitely continued, but there are also successions of increasing integers subject to certain stated conditions, but otherwise arbitrary, which are similarly incapable of indefinite extension.

The following is a simple instance of the kind. Suppose integers to be written down one after the other, no one of which is a multiple of any other, nor the sum of a multiple of any other and of a multiple of a specified one. *Such a succession cannot be indefinitely continued.*

Let a be the specified integer.

1°. Suppose that all the other integers of the succession are prime to a. Then if b be any other of the integers, the equation $ax+by=c$ is soluble in integers if c is greater than ab, as follows at once from the consideration that the numbers $c-b$, $c-2b$, $c-3b \ldots c-ab$ must be all distinct residues to the modulus a, inasmuch as the difference of any two of them being of the form $(i-j)b$ where $i-j$ is less than and b prime to a, cannot be divisible by a.

But if the succession could be indefinitely produced, it must contain a number greater than ab. Hence the theorem is proved for the case where a is prime to every other integer in the succession.

2°. Suppose the theorem to be true for the case where the quotient of a divided by i prime numbers (not necessarily all distinct) is prime to all the other terms of the series: it must be true when the number of such prime numbers is $i+1$. For let p be one of them and $a=pa'$, consider all the terms of the succession divisible by p apart from the rest.

Let $pa', pb', pc' \ldots$ be those terms. By the law of the succession the equation $pa'x+pb'y=pc'$ cannot be satisfied for any values of b', c', and consequently $a'x+b'y=c'$ cannot be satisfied.

Hence by hypothesis since a' divided by i factors is prime to $b', c' \ldots$ the succession of terms divisible by p must be finite in number, and this will be true for every factor p. Hence the succession $b, c, \ldots$ will contain

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*This statement is proved instantaneously by taking one of the elements equal to unity and all the rest zero; and the latter part of it gives a new proof of Cauchy's theorem which he obtains by a consideration of all the possible cyclic representations of the substitutions of n elements. The theorem is that if n elements be divided in every possible way into λ set of l, μ set of m, ν set of $n \ldots$ elements, then

$$\Sigma\frac{1}{\pi\lambda\pi\mu\pi\nu\ldots l^\lambda . m^\mu . n^\nu\ldots}=1.$$

For we know by a theorem of Waring that

$$s_n=\Sigma\pm\frac{1}{\pi\lambda\pi\mu\ldots l^\lambda m^\mu\ldots}\sigma_l^\lambda\sigma_m^\mu\ldots$$

Hence by Crocchi's theorem the sum of the coefficients in h_n expressed in σ's is equal to

$$\Sigma\frac{1}{\pi\lambda\pi\mu\ldots l^\lambda m^\mu\ldots}$$

but it is also equal to unity. Cauchy's theorem is therefore proved.

Again in the formula for s the sign *plus* or *minus* depends on the oddness or evenness of $\lambda+\mu+\ldots$ Hence if in

$$\Sigma\frac{1}{\pi\lambda\pi\mu\ldots l^\lambda m^\mu\ldots}$$

only those values of $\lambda, \mu, \ldots$ are admitted which make $\lambda+\mu+\ldots$ always odd or always even, either sum so formed will be equal to ½, because the difference of the two sums is zero and their sum unity.

This theorem can, of course, be deduced like the former one from the method of cycles applied now, not to the entire number of the substitutions, but to that half of them which correspond to the *alternate group* of each, of which the number of representative cycles (monomial ones included) is always odd or else always even, according as the number of elements is one or the other.

only a finite number of terms having any factor in common with a. Moreover the succession containing a and terms prime to a exclusively, must also be finite by the preceding case. Consequently the whole succession will be finite, and the theorem if assumed to be true for $i=0$, or any positive integer is true for $i+1$.

But by the preceding case the proposition is true when $i=0$. Hence it is true universally.

In the long footnote to the Article on Subinvariants in *Vol. V, pp.* 92, 93 of the *Am. Journal of Math.*, will be found given the mode of extending this theorem to the case of successions of complex integers or multiplets, when a proper restriction is laid upon the ratios to one another of the simple numbers which constitute the multiplets, and a possible connexion pointed out between the finiteness of such successions and that of the system of ground-forms to a binary quantic.

On Subinvariants, i. e., Semi-invariants to Binary Quantics of an Unlimited Order. (Sec. 1, Proem; sec. 2, Germs; sec. 3, Ground-forms—Algebraical Deduction of their Categories—by J. J. SYLVESTER.

[Abstract of a paper in the *American Journal of Mathematics, Vol. V, No.* 1].

Covariants to a given quantic are known when either of their leading coefficients, say when the left hand leading coefficient is given, but this will appertain not merely to the quantic in the case of which it first makes its appearance, but to all quantics of a higher order. The theory of covariants and their ground-forms is consequently simplified and unified by fixing the attention solely on such coefficients or semi-invariants, regarding them as forming one single infinite group of forms, having no reference to any particular quantic and defined exclusively as rational integral values of $\Omega^{-1}0$ (where $\Omega = a\delta_b + 2b\delta_c + 3c\delta_d + \ldots$ *ad libitum*) of which every other value of that expression must be a function.

Such quantities may be termed subinvariants in regard to the elements $a, b, c, \ldots$, and consequently every rational integral value of $\Omega^{-1}0$, where Ω now means *any* numerical linear fuuction whatever of $a\delta_b$, $b\delta_c$, $c\delta_d, \ldots$ is a subinvariant *quâ* corresponding numerical multiples of $a, b, c, \ldots$ as elements. As an immediate corollary from this we see that the remainder of any subinvariant in regard to the first element a, is a subinvariant in regard to a modified set of elements, viz: $b, \frac{c}{2}, \frac{d}{3}, \ldots$, a fact of which an important use is made in the theory of deduction of ground-forms.

The present number of the Journal contains the 1st and 2d sections and a portion of the 3d, the conclusion of which, and two or more sections will be given in the next number of the Journal. In section 1, the elementary properties of subinvariants are deduced directly from their definition, and among other matters a theorem is stated and demonstrated to the effect that any invariant of a system of subinvariants in respect to the highest letter which they contain and unity, is itself a subinvariant; a theorem which is extended to the case of subinvariants of systems of elements; the general definition of such subinvariants is that they mean rational integral values of $\Omega^{-1}0$, when Ω is any numerical linear function of the operators $a\delta_b$, $b\delta_c, \ldots$, *ad inf.*; $a'\delta_{b'}$, $b'\delta_{c'}, \ldots$, *ad inf.*; $a''\delta_{b''}$, $b''\delta_{c''}, \ldots$, *ad inf.*; so that in fact a subinvariant of a system or pluri-subinvariant may be regarded as a special case of a uni-subinvariant in which some of the numerical coefficients become zero, in accordance with the general principle which pervades quantitative science that the relation of general and particular is frequently convertible.

In this section it is averred that the question as to a certain proposition being true or false, made the subject of a prize in an announcement on the cover of preceding numbers of the Journal, must be answered in the negative, as will be shown in a future section.

Finally the remark is made that the coefficient of the highest power of the furthest letter in any subinvariant is also a subinvariant in respect to the same elements. Such coefficient is called the germ of the form to which it belongs.

In section 2, germ tables are given for the ground-forms of the Quintic and Sextic, which for many purposes are as useful as the tables written out *in extenso*.

In section 3, is explained the method of exhaustive algebraical deduction of the ground-forms of a quantic, or rather of its ground semi-invariants from the primaries or proto-morphs (those forms, viz, which are alternately of the second and third degrees in the coefficients and of which every other ground semi-invariant to the same quantic multiplied by a suitable power of the first coefficient is a rational integral function): the deduction is extended from the easy cases of the cubic and quartic to which it had been previously confined, to the quintic by means of the principle of residues explained in the Proem—without which a solution of this problem would have been practically impossible. The deduction is not completed in the present number of the Journal, but the result of the inquiry is that the twenty-three ground-forms of the quintic may be logically arranged in 8 distinct categories, containing respectively 1, 4, 3, 4, 3, 3, 4, 1 individuals, the first and second categories containing respectively the quintic itself and its proto-morphs, and the last one consisting of the skew-invariant. The powers of the first element, by which each deduct must be multiplied in order to become a rational integer function of the proto-morphs, is ascertained, and the highest power which occurs, viz, the integrating factor (so to say) of the last deduct, turns out to be the 23d.

In a long footnote to the part of this section which appears in the present number, is given a theorem of a rather curious nature (as a possible link in a desiderated algebraical proof of Gordan's theorem) concerning certain successions of increasing simple or complex integers subject to a restriction which ensures the *impossibility* of their being indefinitely continued.

I take this opportunity of introducing an *erratum* relating to this footnote, last paragraph: for the words following the word *products*, l. 3, and ending with the word *set*, l. 8, substitute the following:

of the form $b^xQ^yR^zS^tT^u$ such that no one of them could be (a power of one or) a product of powers of any of the others. If then it could be shown that there exists in the succession, a set of quintuplets x, y, z, t, u such that the quotient-system of every other quintuplet in the succession is *intermediate* to the quotient-system of that set.

On a Class of Multiple Algebras, by C. S. PEIRCE.

[Abstract of a paper read before the University Mathematical Society, October 18, 1882].

It is evident that every substitution is a relative term. Thus, the transposition of AB to BA is in relative form $(A:B)+(B:A)$, and the circular substitution $\binom{BCA}{ABC}$ is $(B:A)+(C:B)+(A:C)$. In this point of view, we see that substitutions may be added and multiplied by scalars, although the results will usually no longer be substitutions. A group of substitutions may, then, be linear expressions in an associative multiple algebra of a lower order than that of the group.

The object of this paper is to show what algebras express all the substitutions of two, of three, and of four letters; and to put these algebras into familiar forms.

Of two letters, there are two substitutions $(X:X)+(Y:Y)$ and $(X:Y)+(Y:X)$. We may denote these by a and β respectively, so so that taking A and B as indeterminate coëfficients, the general expression of the algebra is $Aa+B\beta$, or in the form of a matrix is

$$\begin{matrix} A & B \\ B & A. \end{matrix}$$

Assume i and j such that

$$i=\tfrac{1}{2}(a+\beta)$$
$$j=\tfrac{1}{2}(a-\beta).$$

Then the multiplication table of i and j is as follows:

	i	j
i	i	0
j	0	j

The algebra is, therefore, a mixture of two ordinary simple algebras of B. Peirce's form (a_1).

Of three letters, there are *six* substitutions. Let Α, Β, Γ, Δ, Ε, Ζ be indeterminate coëfficients. Then, the general expression of the algebra is equivalent to

$$\begin{matrix} \mathrm{A} & \mathrm{B} & \Gamma \\ \Gamma & \mathrm{A} & \mathrm{B} \\ \mathrm{B} & \Gamma & \mathrm{A} \end{matrix} + \begin{matrix} \Delta & \mathrm{E} & \mathrm{Z} \\ \mathrm{E} & \mathrm{Z} & \Delta \\ \mathrm{Z} & \Delta & \mathrm{E} \end{matrix}$$

Or, denoting the six substitutions by $a, \beta, \gamma, \delta, \varepsilon, \zeta$, we may write the general expression as $\mathrm{A}a+\mathrm{B}\beta+\Gamma\gamma+\Delta\delta+\mathrm{E}\varepsilon+\mathrm{Z}\zeta$. There is an equation between these substitutions, namely:

$$a+\beta+\gamma=\delta+\varepsilon+\zeta$$

Assume 5 relatives h, i, j, k, l, such that

$$h=\tfrac{1}{3}(a+\beta+\gamma)$$
$$i=\tfrac{1}{2}(a-\varepsilon)$$
$$j=\tfrac{1}{3}(\beta-\gamma+\delta-\zeta)$$
$$k=\tfrac{1}{4}(-\beta+\gamma+\delta-\zeta)$$
$$l=\tfrac{1}{6}(2a-\beta-\gamma-\delta+2\varepsilon-\zeta)\ .$$

In matricular form,

$$h=\begin{matrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{matrix} \qquad 2i=\begin{matrix} 1 & -1 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & 0 \end{matrix} \qquad 3j=\begin{matrix} 1 & 1 & -2 \\ -1 & -1 & +2 \\ 0 & 0 & 0 \end{matrix} \qquad 4k=\begin{matrix} 1 & -1 & 0 \\ 1 & -1 & 0 \\ -2 & +2 & 0 \end{matrix}$$

$$6l=\begin{matrix} 1 & 1 & -2 \\ 1 & 1 & -2 \\ -2 & -2 & +4\ . \end{matrix}$$

The multiplication table of h, i, j, k, l, is as follows:

	h	i	j	k	l
h	h	0	0	0	0
i	0	i	j	0	0
j	0	0	0	i	j
k	0	k	l	0	0
l	0	0	0	k	l

The algebra is a mixture of ordinary single algebra (a_1) with the algebra of Hamilton's biquaternions (g_4).

In six letters, there are twenty four substitutions. Using the capital Greek letters for indeterminate coëfficients, the general linear expression in these substitutions is equivalent to

$$\begin{matrix}A&\Delta&\Gamma&B\\ \Gamma&B&A&\Delta\\ B&\Gamma&\Delta&A\\ \Delta&A&B&\Gamma\end{matrix} + \begin{matrix}E&Z&\Theta&H\\ Z&E&H&\Theta\\ \Theta&H&E&Z\\ H&\Theta&Z&E\end{matrix} + \begin{matrix}I&\Lambda&K&M\\ M&K&\Lambda&I\\ \Lambda&I&M&K\\ K&M&I&\Lambda\end{matrix}$$

$$+ \begin{matrix}N&O&\Pi&\Xi\\ O&N&\Xi&\Pi\\ \Xi&\Pi&O&N\\ \Pi&\Xi&N&O\end{matrix} + \begin{matrix}P&\Upsilon&\Sigma&T\\ \Sigma&T&P&\Upsilon\\ \Upsilon&P&T&\Sigma\\ T&\Sigma&\Upsilon&P\end{matrix} + \begin{matrix}\Phi&X&\Psi&\Omega\\ \Omega&\Psi&X&\Phi\\ \Psi&\Omega&\Phi&X\\ X&\Phi&\Omega&\Psi\end{matrix}$$

Using the twenty-four small Greek letters to denote the twenty-four substitutions, so that the general linear expression is $A\alpha + B\beta +$, etc., an attentive observation of the above scheme will show that the following equations subsist:

$$\alpha+\beta+\gamma+\delta=\varepsilon+\zeta+\eta+\theta=\iota+\kappa+\lambda+\mu$$
$$=\nu+\xi+o+\pi=\rho+\sigma+\tau+\upsilon=\phi+\chi+\psi+\omega .$$

Also,

$$\begin{matrix}\alpha+\beta=\nu+\xi & \varepsilon+\zeta=\nu+o & \iota+\kappa=\nu+\pi\\ \alpha+\gamma=\rho+\sigma & \varepsilon+\eta=\rho+\tau & \iota+\lambda=\rho+\upsilon\\ \alpha+\delta=\phi+\chi & \varepsilon+\theta=\phi+\psi & \iota+\mu=\phi+\omega .\end{matrix}$$

It is plain that these equations are all independent, and not difficult to see that there are no more. Since they are fourteen in number, a ten-fold algebra is required to express the twenty-four substitutions.

Assume the ten relatives h, i, j, k, l, m, n, o, p, q, such that

$$\begin{aligned}h&=\tfrac14(\alpha+\beta+\gamma+\delta)\\ i&=\tfrac14(\varepsilon+\zeta-\eta-\theta)\\ j&=\tfrac14(\alpha-\beta+\gamma-\delta)\\ k&=\tfrac14(\iota-\kappa-\lambda+\mu)\\ l&=\tfrac14(\iota-\kappa+\lambda-\mu)\\ m&=\tfrac14(\varepsilon-\zeta-\eta+\theta)\\ n&=\tfrac14(\alpha+\beta-\gamma-\delta)\\ o&=\tfrac14(\alpha-\beta-\gamma+\delta)\\ p&=\tfrac14(\iota+\kappa-\lambda-\mu)\\ q&=\tfrac14(\varepsilon-\zeta+\eta-\theta)\end{aligned}$$

In matricular form, these are as follows, (where + is written for +1 and — for —1) .

$$4h=\begin{matrix}+&+&+&+\\+&+&+&+\\+&+&+&+\\+&+&+&+\end{matrix}$$

$$4i=\begin{matrix}+&+&-&-\\+&+&-&-\\-&-&+&+\\-&-&+&+\end{matrix}\qquad 4j=\begin{matrix}+&-&+&-\\+&-&+&-\\-&+&-&+\\-&+&-&+\end{matrix}\qquad 4k=\begin{matrix}+&-&-&+\\+&-&-&+\\-&+&+&-\\-&+&+&-\end{matrix}$$

$$4l=\begin{matrix}+&+&-&-\\-&-&+&+\\+&+&-&-\\-&-&+&+\end{matrix}\qquad 4m=\begin{matrix}+&-&+&-\\-&+&-&+\\+&-&+&-\\-&+&-&+\end{matrix}\qquad 4n=\begin{matrix}+&-&-&+\\-&+&+&-\\+&-&-&+\\-&+&+&-\end{matrix}$$

$$4o=\begin{matrix}+&+&-&-\\-&-&+&+\\-&-&+&+\\+&+&-&-\end{matrix}\qquad 4p=\begin{matrix}+&-&+&-\\-&+&-&+\\-&+&-&+\\+&-&+&-\end{matrix}\qquad 4q=\begin{matrix}+&-&-&+\\-&+&+&-\\-&+&+&-\\+&-&-&+\end{matrix}$$

The multiplication table is as follows:

	h	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*
h	*h*	0	0	0	0	0	0	0	0	0
i	0	*i*	*j*	*k*	0	0	0	0	0	0
j	0	0	0	0	*i*	*j*	*k*	0	0	0
k	0	0	0	0	0	0	0	*i*	*j*	*k*
l	0	*l*	*m*	*n*	0	0	0	0	0	0
m	0	0	0	0	*l*	*m*	*n*	0	0	0
n	0	0	0	0	0	0	0	*l*	*m*	*n*
o	0	*o*	*p*	*q*	0	0	0	0	0	0
p	0	0	0	0	*o*	*p*	*q*	0	0	0
q	0	0	0	0	0	0	0	*o*	*p*	*q*

The algebra is, therefore, a mixture of ordinary algebra with that of my nonions.

[Of course, the representation of quaternions as linear expressions in substitutions of three letters, the sum of the coëfficients being zero, is equivalent to finding *a theorem of plane geometry corresponding to each theorem of solid geometry expressible by quaternions.* For instance, let the three letters which are interchanged by the coördinates x, y, z, of a point in space. Then, as above, let

$$\alpha=\begin{pmatrix}x, y, z\\ x, y, z\end{pmatrix}\qquad \beta=\begin{pmatrix}z, x, y\\ x, y, z\end{pmatrix}\qquad \gamma=\begin{pmatrix}y, z, x\\ x, y, z\end{pmatrix}$$
$$\delta=\begin{pmatrix}x, z, y\\ x, y, z\end{pmatrix}\qquad \varepsilon=\begin{pmatrix}y, x, z\\ x, y, z\end{pmatrix}\qquad \zeta=\begin{pmatrix}z, y, x\\ x, y, z\end{pmatrix} .$$

Thus, β and γ represent the operations of rotation through one-third of a circumference, the one forward, the other backward, about an axis passing through the origin and the point (1, 1, 1); while δ, ε, ζ represent three perversions with reference to axes passing through the origin and the points (0, 1, — 1), (1, — 1, 0), and (1, 0, — 1), respectively. Quaternions may be represented thus:

$$\begin{aligned}1&=\tfrac13(2\alpha-\beta-\gamma)\\ i&=-\tfrac13(2\varepsilon-\delta-\zeta)\sqrt{-1}\\ j&=\frac{1}{\sqrt{3}}(\beta-\gamma)\\ k&=\frac{1}{\sqrt{3}}(\delta-\zeta)\sqrt{-1} .\end{aligned}$$

We have here a new geometrical interpretation of quaternions. Since the sum of the coëfficients of the substitutions is equal to zero in the values of every one of the quaternion elements, it follows that under this interpretation any quaternion operating upon any point brings it into the plane.

$$x+y+z=0 .$$

Hence, every quaternion equation has an interpretation relating to points in this plane. The reason why a quaternion, which has a four-fold multiplicity, is no more than adequate to expressing operations upon points in space, is that the operations are of such a nature that different ones may have the same effect upon single points. But a *real* quaternion has no greater multiplicity than the real and imaginary points of a plane; and the geometrical effects of different real quaternions upon points in the plane $x+y+z=0$ under the new interpretation are different upon all points except the origin.

For the axes of x, y, z, in trilinear coördinates, take three lines meeting in one point and equally inclined to one another. To plot the point $x=a+b\sqrt{-1}$, $y=c+d\sqrt{-1}$, $z=e+f\sqrt{-1}$, plot the point $x=a$, $y=c$, $z=e$ in *blue*, and the point $x=b$, $y=d$, $d=f$ in *red*. Then the effects of the different quaternion elements upon points in the plane $x+y+z=0$ are as follows: 1 leaves every point unchanged. The vector i reverses the position of a blue point with reference to the line $z=0$ and changes it to red, and reverses the position of a red point with reference to the line $x=y$ and changes it to blue. The vector j rotates every point through a quadrant round the origin in the direction from $x=0$ to $y=z$, without changing the color. The vector k reverses the position of a blue point with reference to the line through the origin that bisects the angle between $y=0$ and $y=z$ and changes it to red, and reverses the position of a red point with reference to the line through the origin that bisects the angle between $x=0$ and $x=z$ and changes it to blue.—*Added*, Oct. 30.]

[Abstracts of other papers are printed under "American Journal of Mathematics," p. 7.]

Physics.

On Atmospheric Electricity, by H. A. Rowland.

[Presented to the Congress of Electricians, Paris, September 17, 1881, and here translated from their Proceedings].

Among the subjects to be discussed by this congress is that of atmospheric electricity, and I should like, at this point, to urge the importance of a series of general and accurate experiments performed simultaneously on a portion of the earth's surface as extended as possible. Here and there on the globe, it is true, an observer has occasionally performed a series of experiments, extending even over several years: but the different observers have not worked in accordance with any preconcerted plan, it has not been possible to compare their instruments, and even where absolute measurements have been obtained, the exact meaning of the quantity measured has not been perceived. Let us take, for instance, Sir William Thomson's water dropping apparatus, which is used at the Kew Observatory. This apparatus is composed of one tube rising a few feet above the building and of another tube near the ground, so that it is in the angle made by the house and the ground. This apparatus indicates a daily variation in the electricity of the atmosphere, but the result is evidently influenced by the conditions of the experiment. Another observer who should fit up an apparatus in another country might obtain entirely different conditions, so that it would be impossible to compare the results. Hence the necessity of having a system.

The principal aim of scientific investigation is to be able to understand more completely the laws of nature, and we generally succeed in doing this by bringing together observation and theory. In science proper, observations and experiments are valuable only in so far as they rest on a theory either in the present or in the future. We can as yet present only a plausible theory of atmospheric electricity, but the real way of arriving at the truth in this case is to let ourselves be guided in our future experiments by those which have hitherto been made on this subject.

The principal facts which have been discovered can be stated in a few words. In clear weather, the potential increases as we go higher, at least for certain parts of Europe, and there is a diurnal and annual variation of this quantity which the presence of fogs causes also to vary. The first observers were inclined to attribute the electricity of the atmosphere to the evaporation of water, and an old experiment which consisted in dropping a ball of red-hot platinum into water placed on a gold leaf electrometer, was supposed to confirm this view. Even recently a distinguished physicist held this opinion in the case of electric storms. Now when a ball of platinum is thus dropped into water, the excessive commotion thus produced will certainly give rise to electricity; but to assert that this electricity is due to evaporation may very well be an error. It is true that occasionally a red-hot meteorite may fall into the sea, reproducing thus the laboratory experiment; but most of the water is evaporated quietly. Recently one of my students used under my direction a Thomson quadrant electrometer in order to investigate this question, and although he evaporated large quantities of different liquids, he did not find any trace of electrization. I hope to prove thus conclusively that the electricity of the atmosphere cannot be the result of evaporation.

Sir William Thomson thinks that the experiments which have been made hitherto indicate that the earth is charged negatively. This conclusion would certainly explain all the experiments hitherto performed in Europe; but the only method of reaching certainty on this point is to execute a series of experiments on the whole surface of the globe, and it is this method that I propose to-day. This series of experiments would furnish data for determining not only the fact of terrestrial magnetism, but also by the aid of Gauss's theorem the amount of the charge on the solid portion of the earth; however, this amount cannot be determined for the upper atmosphere. What we want to know is the law according to which the electric potential varies as we ascend on the whole surface of the globe and at the same instant of time, so that it may be possible to obtain the surface integral of the rate of variation of the potential over the whole globe. If the earth were ever to receive an increase of charge coming either from the exterior or from the upper atmosphere, this increase would be known. When, in the London Physical Society, I criticized the theory of Profs. Ayrton and Perry on terrestrial magnetism, I gave at the end of my paper a brief outline of a recent theory on auroras and storms, which was built on the hypothesis of the electrization of the earth. After mature reflection I still wish to present to you this theory, which deserves to be thought of in mapping out a system of international experiments on atmospheric electricity.

Suppose Sir William Thomson's explanation is correct and that the earth is charged with electricity, let us examine what would then happen. If the earth were not exposed to disturbing causes, a portion of the electricity of the globe would discharge itself into the atmosphere and would distribute itself nearly as uniformly as the resistance of the air would allow. The exterior atmosphere thus charged would set itself in motion, and we should have winds produced by the electric repulsions, and this would last until the electricity had been distributed in a uniform manner on the earth and in the exterior strata of the atmosphere; when all would be still once more. An observer stationed on the earth would have no idea of the charge of the exterior atmosphere; but he would discover the charge of the earth by means of the ordinary instruments used in experiments on the electricity of the atmosphere, such as Becquerel's arrows and Thomson's water dropping apparatus. There would be another result which however could not be measured by observers situated on the earth, namely, the extension of the atmosphere beyond the limits determined by calculation. The rarefied air being electrified would repel itself, and possibly there would be then in the exterior atmosphere a region in which the pressure would vary very slightly for a great difference of elevation. We have learned from auroras and meteors that the atmosphere extends to a much greater distance than that indicated by Newton's logarithmic formula, but I think that what I have said is the first rational explanation of this fact.

Observe now what would happen if the earth of which we speak were subject to the disturbing causes which exist on our globe; the most important of these disturbing factors are the winds and the general atmospheric circulation. This circulation constantly carries the atmosphere from the equator to the two poles, but with very little uniformity. However, near the poles there must be many points at which the air comes down towards the earth and thus shapes its course towards the equator. Now a body which is a bad conductor, like air, when it is charged tends to carry its charge along with it wherever it goes, and thus the air carries its charge until the moment when it descends towards the earth; then it will leave it behind in the exterior atmosphere, in accordance with the tendency of electricity to remain at the surface of charged bodies. The charge will therefore accumulate in the exterior atmosphere, until there is a great tension; the atmosphere will then discharge itself either towards the earth or through the rarefied air in the shape of an aurora. At these points the rarefied air probably heaps itself up to a greater height than elsewhere, which would explain the great height at which auroras are sometimes observed.

The equilibrium which existed previously at the equator would also be destroyed by the absence, at this point, of the primitive charge in the exterior atmosphere, and the earth would have a tendency to discharge itself towards the exterior atmosphere. Owing to the difference in the conditions at this point, this tendency will be apt to show itself by the storms which arise oftenest in the equatorial region. Thus the electricity of the earth would tend to circulate in the same way as the air from the equator to the poles and conversely.

But I do not intend to insist upon this theory here; I wish simply through it to bring out the importance of establishing on the whole surface of the globe a system of general observations on atmospheric electricity. Even if the theory is false, it is only by observation that the truth can be attained. In my opinion, it is almost unworthy of the advanced state of our sciences to-day, that it should be at present impossible for us to indicate accurately the origin of the energy which manifests itself in auroras and storms. For I have pointed out above that it is necessary to give up explaining these phenomena by the hypothesis of the production of electricity by evaporation.

I propose therefore that from this section of the Congress a committee be formed to examine what is to be done in order to establish on the whole earth, and especially in the polar regions, a systematic series of observations on atmospheric electricity.

EDITORIAL NOTE.—*International Commission of Electricians.*

[Professor Rowland sailed from New York, October 14, to attend an international commission of electricians, then about to assemble in Paris. Professor John Trowbridge of Cambridge sailed about the same date. These two gentlemen were selected to represent the United States government by the Department of State—Congress having made provision for the appointment of two civilian commissioners.

This official commission is the outgrowth of the congress of electricians which was held a year ago in Paris. That body requested the French government to invite other nations to unite in constituting three international commissions for the study of certain specified problems, namely:

I. A re-determination of the value of the ohm.
II. (*a*) atmospheric electricity.
    (*b*) protection against damage from telegraphic and telephonic wires—(*paratonnerres*).
    (*c*) terrestrial currents on telegraphic lines.
    (*d*) the establishment of an international telemeteorographic line.
III. Determination of a standard of light.

The study of atmospheric electricity was proposed to the congress by Mr. Rowland. After hearing his paper on this subject, the section to which he belonged adopted on his motion the following resolution which was subsequently approved by the entire congress:

Resolved that an international commission be charged with determining the precise methods of observation for atmospheric electricity, in order to generalize this study on the surface of the globe.

As Mr. Rowland did not retain his manuscript, the foregoing translation of the paper as it is printed in the *Comptes Rendus* of the congress has been made by Mr. P. B. Marcou and is printed here with the author's consent.]

Philology.

On Grammar and Aesthetic, by B. L. GILDERSLEEVE.

[Abstract of a paper read before the University Philological Association, October 6, 1882].

Scientific grammar has become more and more professional, more and more detailed. Phonology has grown into a department which threatens to overshadow the rest of philology. The theory of formations has been turned into a mechanical assemblage of facts, and the brilliant generalizations once in vogue have been abandoned one by one. Syntax has divorced itself from logic and turned statistical. Such is the present condition of grammar, minute and skeptical. On the other hand aesthetic criticism is losing itself in mere finical fault-finding and sympathetic phrase-mongery, and the chasm between the grammarian and the man of letters is daily widening. To effect a reconciliation of these two extremes may be impossible. To examine the conditions of such a reconciliation is legitimate.

In antiquity, literary criticism took into account much that is now relegated to the grammar, phonetics, word-formation, syntax, prosody. Now all these matters fall under the observation of the scientific grammarian, all are subjected to rigid measurement and computation, and all the minute grammatical research of the day may be made available and is to be made available for literary criticism, for aesthetic appreciation. At all events the effort to get exact expression for every manifestation of spiritual life is not unworthy of the highest intellectual faculties.

On the Locality to which must be Assigned the Treatise of Palladius de Agri Cultura, by J. Rendel Harris.

[Abstract of a paper read before the University Philological Association, October 6, 1882].

This paper was an attempt to decide the question whether Palladius was an inhabitant of Gaul in the fifth century, or of Italy at a date some two or three centuries earlier, by means of the table of lengths of shadows given by the writer for every month in the year, and the several hours of the day.

It was shown that the measurements would not agree with the shadows of a sun-dial, but that they represented very closely the shadows of a staff five feet high placed in a latitude at least as high as 45°. It was, therefore, inferred that the author of the treatise was the son of Exsuperantius, the prefect of Gaul in the earlier part of the fifth century, whom Jerome invited in one of his letters to enter upon a monastic life, and who was finally killed in 424, during a mutiny of his soldiers.

The paper will appear at length in the next number of the *American Journal of Philology.*

On a Probable Error in Plutarch's Life of Pericles, c. 23, by C. D. Morris.

[Abstract of a paper read before the University Philological Association, October 6, 1882].

Plutarch states that when Eubœa had been reduced after its revolt by Pericles, B. C., 445, *Χαλκιδέων τοὺς ἱπποβότας λεγομένους πλούτῳ καὶ δόξῃ διαφέροντας ἐξέβαλεν.* This statement is accepted without remark by Thirlwall, Grote, Curtius, and Bœckh. But we learn from Herodotus, v. 77, that after a victory over the Chalcidians, which occurred about B. C. 507, the lands of these same Chalcidian nobles had been occupied by a body of four thousand Athenian citizens who were sent there as *κληροῦχοι.* These Cleruchs are found still in the occupation of their lands at the time of the battle of Marathon; and there is no reason to believe, and Bœckh expressly denies, that they abandoned them at that time except for a moment when under the stress of terror at the Persian invasion. It is highly improbable, therefore, that under the continued and increasing power of the Athenians, any such number of the Chalcidian nobles could have succeeded in re-occupying their old possessions as to make their expulsion a second time worthy of record. When we add to this the fact that Thucydides in his account of the expedition of Pericles, (i. 114), makes no mention of the Chalcidians, though he does say that the inhabitants of the district of Hestiaea were expelled—a fact which Plutarch also states—the probability that Plutarch is in error is much increased. Indeed the words of Thucydides—*τὴν μὲν ἄλλην* [Εὔβοιαν] *ὁμολογίᾳ κατεστήσαντο, Ἑστιαιᾶς δὲ ἐξοικίσαντες αὐτοὶ τὴν γῆν ἔσχον*—imply that the only part of the island treated with exceptional severity was the northern district. It seems likely therefore that Plutarch states as one of the results of the expedition of Pericles a measure which had really been adopted some sixty years before. And it is not unnatural that he should have done so, since the circumstances of the two expeditions are curiously alike in several particulars.

Notes from the Greek Seminary, by B. L. Gildersleeve.

[Abstract of a paper in the *American Journal of Philology, No.* 10].

In the first section of these notes, Professor Gildersleeve discusses the use of the articular infinitive, giving an abstract of previously published papers, and supplementing the statistics there presented by a *résumé* of the investigations of Dr. G. F. Nicolassen in Xenophon, and of Mr. W. S. Fleming in Plato. The tenses in Xenophon are mostly the present and the aorist, sometimes the perfect, and in a few instances the future infinitive and the infinitive with *ἄν*, both which are due to the influence of *oratio obliqua.* Of the cases, the nominative and accusative largely preponderate. Then comes the genitive, which is freely used. Prepositions appear in great number and variety. The maximum of occurrence, taking the Teubner page as a standard, is found in the Hipparchikos (2, 67), the minimum in the Respublica Atheniensium, which is not by Xenophon. The average of Xenophon is slightly higher than that of Thukydides—a difference which may readily be accounted for by the philosophical character of so many of Xenophon's writings. Plato, according to Mr. Fleming, uses twenty-five prepositions and *quasi* prepositions against fifteen in Thukydides, and the articular present infinitive is much more common than the aorist, due doubtless to the philosophical consideration of the character of the action rather than of its manifestations. In the second part, Professor Gildersleeve has reproduced his treatment of *οὐ μή*, prepared for another purpose and has amplified it on one or two points.

[Abstracts of other papers are printed under "The American Journal of Philology," page 7].

Biology.

[Abstracts of Results of Researches at Marine Laboratory, Session of 1882-3. Continued from Circular No. 17].

The Metamorphosis of Penaeus, by W. K. Brooks.

Scarcely another fact in morphological science, standing alone, exceeds in interest the discovery that Penaeus, a Decapod, passes through a Nauplius stage.

Those familiar with the literature of the subject will recollect that Fritz Müller kept under observation until it changed into a Protozoea, a Nauplius which he captured at the surface of the ocean.

He also secured, in the ocean, a very complete series of larvae, through which he identified his Protozoea with a young Macrouran with the characteristics of the genus Penaeus.

He did not rear the Nauplius from a Penaeus egg; nor did he actually observe the transformation into the young Penaeus. Certain over-cautious naturalists have therefore refused to accept his conclusions until more conclusive proof should be furnished.

A number of stages in the development of Penaeus have been figured and described by Claus, but as he also relied upon surface collecting his evidence is open to the same objection.

Although I have shown, by tracing from end to end the life history of Lucifer, that this Macrouran undergoes a series of changes almost perfectly parallel to those which Fr. Müller describes in Penaeus, it is still desirable, as a matter of history, and in order to set at rest those critics who refuse to give any weight to deductive reasoning in Morphology, to trace the life-history of Penaeus, by actually witnessing the changes.

I have been able this summer, at the marine laboratory of the Johns Hopkins University, to obtain the youngest Protozoea stage of Penaeus; the stage which Fr. Müller actually reared from the Nauplius. I have had the good fortune to rear this larvae in the house, and to witness in isolated captive specimens every one of the five moults between the first Protozoea and the young Penaeus. During June and July, the breeding season, the mature females cannot be found inside the Sounds of our coast, and as our boat is too small for outside work during these windy months, I have not been able to secure the eggs or Nauplii; but this, the only gap in my series, is filled by Fr. Müller's observation. The whole metamorphosis of Penaeus has therefore been actually witnessed, and there is no longer any room for criticism.

Protozoeas apparently identical with the youngest one figured by Müller, and which a comparison with Lucifer shows to be in the "First Protozoea" stage, were captured at the surface of the inlet, by the hand net.

They were carefully drawn and measured, and were then placed in tumblers, one in each tumbler, and were kept thus isolated and under observation until they assumed the characteristics of the genus Penaeus, which they did after five moults.

The first Protozoea has an ocellus, a very short rostrum, and traces of the compound eyes, which are not yet movable The first and second antennae are Nauplius-like, and the biramous second antennae are the chief organs of locomotion. The labrum has a short spine; the mandibles are stout-cutting blades, with no trace of a palpus, or of the swimming branches of the appendage. The first maxilla is small and jaw-like, while the second is long and slender, with a very small scaphognathite. There are three pairs of Maxillipeds, all of them biramous. The first pair are large, fringed with long swimming hairs, and they are efficient swimming organs. The second pair are much smaller, and of less functional importance, and the third pair are rudimentary, and scarcely visible. The long, slender hind body shows only very faint traces of a division into segments, and no ganglia could be made out. The tip of the abdomen forms a forked telson, with seven pairs of plumose hairs; one short one on the inside edge; another short one on the outside edge; and a terminal row of five much longer ones, the middle one being the longest of all.

After moulting, the "Second Protozoea" is essentially like the first, the chief differences being that the compound eyes are now movable, and the hind body is sharply divided into segments. No joint as yet separates the telson from the sixth abdominal segment, but, with this exception, all the segments of the hind body are now well defined.

In the species which was studied, probably Penaeus Braziliensis, the rudimentary thoracic and abdominal appendages, described by Claus at this stage, were not visible. I did, however, find a few specimens of another species, which agreed, in this respect, with Claus's figure.

After the next moult the larva becomes, what I have called in my paper on Lucifer, a "Protozoea with preparations for the Schizopod Stage."

It might, perhaps, be spoken of as a Zoea. The ocellus is still present, although the compound eyes are large and quite movable.

The rostrum is lengthened. The two pairs of antennae retain the Nauplius characteristics.

The mandible has no trace of a palpus, and the Metastoma consists of a pair of broad, flat plates, separated from each other on the middle line, and placed in the same series with the other appendages.

The maxillae and maxillipeds are as they were at the stage before, except that the third pair of maxillipeds are a little larger, although they are still rudimentary.

The five thoracic somites are now cemented together, and each bears a pair of buds or pouches, the rudimentary appendages.

The telson is separated by a joint from the sixth abdominal segment, and the latter carries a pair of rudimentary swimmerets. There are no traces of appendages on any of the other abdominal segments, although all the ganglia are conspicuous and well developed. The halves of the fork of the telson diverge from each other a little more than they did during the earlier Protozoean stages.

After the next moult the animal reaches the Schizopod stage, so far as the anterior half of the body is concerned, although the abdominal appendages are still absent. The ocellus is still present, as in the first Protozoea, but the character of the antennae has changed completely. The ear has appeared in the basal joint of the first antennae, and contains diatoms and other foreign bodies. The two-jointed basal portion of the second antennae carries a short pouch, the rudimentary flagellum, and a long scale, with plumose hairs and a single spine.

The palpus has appeared on the mandible. The exopodites of all five pairs of legs are large, and are now, with the swimmerets, the locomotor organs. The endopodites of the fourth and fifth pairs are somewhat less developed than those of the first, second, and third pairs, which now end in chelae. The abdomen carries only one pair of appendages, those of the sixth segment, but these are now larger, and are used in swimming.

The tip of the telson is now almost square, with a very slight notch in the middle line.

After the next moult the chief change consists in the formation of the first five pairs of abdominal appendages. The endopodites are absent, and the whole appendage is rudimentary, and is not used for locomotion until the next stage.

After the next moult the animal reaches the Penaeus stage. The scale of the antennae becomes broad and triangular, the flagellum is greatly elongated, and is divided into twelve joints. The mandibular palpus is greatly enlarged, and covers up the bases of the antennae. The exopodites disappear from all five pairs of legs, and the abdominal appendages are now functional, although the endopodites are still absent.

This stage is reached by the first Protozoea in about three weeks, and all the changes have been actually witnessed in isolated captive specimens.

Our boat is too small for work outside during the windy months of June and July, and as the ripe females do not come into the inlets and sounds, I have not been able to obtain the eggs or the newly hatched young; but this is the less important as Fr. Müller reared his "first Protozoea" from a Nauplius, so that we now have the entire metamorphosis from actual observation.—(*Beaufort, Aug.* 16, 1882.)

On the Growth of the Molluscan Shell, by H. L. Osborn.

The structure of the molluscan shell has been studied by means of sections of adult shells by Carpenter and others, and they have found that it presents an outer membranous horny epidermis and an internal stony portion. Such a method could not give any idea of the actual process of shell formation and a knowledge of this could be gained only by study of the first steps. To this end, edges of the shell were snipped away and a thin glass circle thrust between the animal and its shell, care being taken to prevent injury to the mantle. After the lapse of twenty-four hours the shell was opened and the glass circle carefully examined, others were allowed to remain two days, three days, or for periods of weeks.

In twenty-four hours it was found that a film had been left upon the circle; in forty-eight hours, this film was plainly stony. The earliest traces of this film, when treated with coloring reagents, stain, but, when treated with acids, show no traces of lime, nor any evidences of structure; it is simply a structureless membrane. Later films, when treated with acetic acid, present the appearance of a tesselated pavement, and when examined with the polariscope and not treated with acetic acid show beautifully the presence of lime.

It would thus appear that the epithelium of the mantle pours out a secretion of horny matter which forms the epidermis; that this secretion holds lime in solution; and that from this the stony internal portion of the shell is formed. Experiments were successfully made upon the shells of the oyster and *Pinna* and several other lamellibranchs, and some gasteropods were tried, but thus far in vain.

SYNOPSIS OF THE RECENT SCIENTIFIC JOURNALS

Published here.

American Journal of Philology. Edited by Professor Gildersleeve. *No.* 10.

Article I.—The New Revision of King James' Revision of the New Testament, II., by Charles Short.

In this article, the first part of which was published in No. 6 of the *Journal*, Professor Short has examined the changes made by the revisers in the Greek text, and in the translation of the first seven chapters of the Gospel according to St. Matthew. The numerous details forbid any attempt at an abstract, but it may be mentioned that many points of general philological and literary interest are taken up, *e. g.*, the use of *it* as an antecedent, of *which* with reference to persons, of the article with names of rivers, of English indicatives and subjunctives, of *while* and *whiles*, *beside* and *besides*, and other doublets, on the singular verb with compound subject. The article serves to show how many of the changes of the revisers have been anticipated by other translators, so that the novelty lies in the selection of older renderings rather than in the introduction of new.

Article II.—Nonius Marcellus, II., by Henry Nettleship.

Professor Nettleship, in accordance with his purpose announced in the preceding number (9), has applied his method to the analysis of the first book of Nonius Marcellus, and has endeavored to show what parts may be referred to Paulus and through Paulus to Verrius Flaccus, and what parts go back to other sources.

Article III.—Notes from the Greek Seminary, by the Editor.

(An abstract of this paper is printed on page 6).

Article IV.— Greek Inscription from Gerasa in Syria, by F. D. Allen.

A poetical inscription found by Rev. Dr. Selah Merrill in 1876, near Gerash, is here edited with a reduction of the rubbing.

In the *Notes*, Professor E. P. Morris disputes M. Martha's views on the use of "*malum* as an interjection." Professor H. E. Shepherd calls attention to "Jefferson as a Philologist," and Professor C. D. Morris proposes a transposition in Demosthenes, 34. 25.

There are *Reviews* of Zupitza's *Sammlung Englischer Denkmäler in kritischen Ausgaben*, by Professor S. Primer; of Schröer's *Faust*, by Professor J. M. Hart; of Klinkenberg's *De Euripideorum Prologorum Arte et Interpolatione*, by Professor J. H. Wheeler; of Rutherford's *New Phrynichus*, by the Editor; of Dahl's *Lateinische Partikel* ut, by Dr. Minton Warren; of Meier's *Gladiatura Romana*, by the same; of Delbrück's *Einleitung in das Sprachstudium* and Channing's translation of it, by Dr. E. W. Hopkins.

The *Reports* give abstracts of *Rheinisches Museum*, *Mnemosyne*, *Archaeologische Zeitung*, *Germania*, and *Fleckeisen's Jahrbücher*.

No. 11, now in press, will contain, among others, articles on *Combinations with the Perfect Participle in English*, by Fitzedward Hall; on the *Culex of Vergil*, by Robinson Ellis; on *Creole French*, by Professor J. A. Harrison; *Etymological Notes*, by J. P. Postgate; and on the *Arsenal of Philon*, by T. W. Ludlow.

American Chemical Journal. Edited by Professor Remsen. *Vol. IV. No.* 4.

Article I.—Determination of Organic Matter in Potable Water, by J. W. Mallet.

Article II.—On certain Tetrasubstituted Proprionic Acids, by H. B. Hill and C. F. Mabery.

Article III.—On the Constitution of the Substituted Acrylic and Proprionic Acids, by H. B. Hill.

Article IV.—Crystalline Form of Tribromacrylic Acid, by W. H. Melville.

Article V.—Determination of Boracic Acid, by **Edgar F. Smith.**

Article VI.—On the Reduction of Ferric Solutions, by **P. T. Austen** and **G. B. Hurff.**

Article VII.—Note on the Precipitation of Stannic Oxide from Sodium Stannate, by **P. T. Austen.**

Article VIII.—On the Determination of the Flashing Point of Petroleum, by **J. T. Stoddard.**

Article IX.—Friedrich Wöhler, by **The Editor.**

Reviews and Reports.

Analytical Chemistry.

Carbonic Acid in the Air.

On Some Recent Improvements in Industrial Chemistry, by **Walter Weldon.**

Chemical Nomenclature.

Notes.

Recent Publications Relating to Chemistry.

American Journal of Mathematics. Edited by PROFESSOR SYLVESTER. *Vol. V. No.* 1.

Article I.—Quelques Applications de la Théorie des Formes Binaires aux Fonctions Elliptique, by **Faà de Bruno.**

The author proposes to express the elements of the elliptic functions as functions of the absolute invariant. The general theorem obtained is as follows. Let

$$V=a_0y^4+4a_1y^3+6a_2y^2+4a_3y+a_4$$

$$I_2=a_0a^4-4a_1a^3+8a_2$$

$$I^3=\begin{vmatrix}a_0 & a_1 & a_2\\ a_1 & a_2 & a_3\\ a_2 & a_3 & a_4\end{vmatrix}, \Delta=I_2^3-27I_3^2>0$$

$$I=\frac{I_2^3}{I_3^2}, H=\frac{\Delta}{I_2^3}=1-\frac{27}{I}$$

$$T=\frac{1}{4}\left\{\left(\frac{4}{27}H\right)+\frac{6}{2}\left(\frac{4}{7}H\right)^2+\frac{9.8}{2.3}\left(\frac{4}{7}H\right)^3+\dots\right\}$$

$$k^2=\frac{\sqrt{1+T}-1}{\sqrt{1+T}+1}$$

$$\rho=i\sqrt[4]{8}\sqrt[12]{\frac{\Delta}{H}}\left\{\frac{1+\sqrt{1+T}}{\sqrt[4]{1+4T}}\right\}^{\frac{1}{2}}$$

then wé shall have

$$\int\frac{dy}{\sqrt{Y}}=\frac{1}{\rho}\int\frac{dx}{\sqrt{(1-x^2)(1-k^2x^2)}}$$

where, with the exception of the factor $\sqrt[12]{\Delta}$, the right hand side is a function only of the absolute invariant H or I.

A series is found for K which converges very rapidly, viz.,

$$K=\frac{2k'}{(1+\sqrt{k'})^2}\left[1+\left(\frac{1}{2}\right)^2\left(\frac{1-\sqrt{k'}}{1+\sqrt{k'}}\right)^4+\left(\frac{1.3}{2.4}\right)\left(\frac{1-\sqrt{k'}}{1+\sqrt{k'}}\right)^8\right.$$
$$\left.+\left(\frac{1.8.5}{2.4.6}\right)^2\left(\frac{1-\sqrt{k'}}{1+\sqrt{k'}}\right)^{12}+\dots\right]$$

the law of the series is obvious. This compared with the series given by Gauss, which expresses the reciprocal of the arithmetico-geometrical mean $M(1-x, 1+x)$, gives at once

$$K=\frac{\pi}{M(1+k', 2\sqrt{k'})}.$$

Article II.—The Intersection of Circles and the Intersection of Spheres, by **Benjamin Alvord.**

The first problem is to draw a circle cutting three given circles at the same given angle.

The next is to draw a sphere which shall cut each of four spheres at a given angle.

Then two problems proposed by Steiner are solved, viz., to draw a circle which shall cut four given circles at the same (unknown) angle, and to describe a sphere cutting each of five given spheres at the same (unknown) angle. The solutions given are purely geometrical. The author gives the number of solutions of each problem, showing that there are 96 solutions of the problem of drawing a circle which shall cut each of four given circles at the same angle, and 640 solutions of the problem to describe a sphere cutting five given spheres under the same angle.

Article III.—Tables of the Symmetric Functions of the Twelfthic, by **W. P. Durfee.**

The article gives in tabular form the values of the functions (of weight twelve) of the coefficients of the twelfthic in terms of the symmetric functions of its roots, and also the values of these symmetric functions of the roots in terms of the coefficients.

The symmetry of the tabulated results was made use of to check against errors. As a final test of the second table, the sum of all the coefficients was found to be zero.

Article IV.—Some Elliptic Function Formulae, by **Thomas Craig.**

Forms are given, which the author believes to be new, for the differential coefficients of the elliptic functions with respect to the modulus. These are, viz.,

$$\frac{d\mathrm{sn}u}{dk}=\frac{-1}{kk'^2}\mathrm{cn}u\mathrm{dn}u\left\{\left(\frac{E}{K}-k'^2\right)u+\frac{\Theta'(u)}{\Theta(u)}\right\}+\frac{k}{k'^2}\mathrm{sn}u\mathrm{cn}^2u$$

$$\frac{d\mathrm{cn}u}{dk}=\frac{1}{kk'^2}\mathrm{sn}u\mathrm{dn}u\left\{\left(\frac{E}{K}-k'^2\right)u+\frac{\Theta'(u)}{\Theta(u)}\right\}-\frac{k}{k'^2}\mathrm{sn}^2u\mathrm{cn}u$$

$$\frac{d\mathrm{dn}u}{dk}=\frac{k}{k'^2}\mathrm{sn}u\mathrm{cn}u\left\{\left(\frac{E}{K}-k'^2\right)u+\frac{\Theta'(u)}{\Theta(u)}\right\}+\frac{k^3}{k'^2}\frac{\mathrm{sn}^2u\mathrm{cn}^2u}{\mathrm{dn}u}$$

On substituting for sn$u$, cn$u$, dn$u$, their values expressed in terms of the Θ-functions, the right sides of the above equations are made to contain only Θ, E, and K.

Integrals of certain rational functions of sn$u$, cn$u$, dn$u$, are considered, and formulae of integration are found for 89 different cases. The integrals are found by aid of a formula of differentiation given by Mr. Glaisher at the meeting of the British Association in 1881; this is

$$\frac{d^2}{du^2}\mathrm{sn}^u u=u(u-1)\mathrm{sn}^{u-2}u-u^2(1+k^2)\mathrm{sn}^u u+u(u+1)k^2\mathrm{sn}^{u+2}u.$$

Formulae are given for $\int\mathrm{sn}^\alpha u\,\mathrm{cn}^\beta u\,\mathrm{dn}^\gamma u\,du$ for all positive or negative integer values of α, β, γ.

Article V.—Note on the Counter-Pedal surface of an Ellipsoid, by **Thomas Craig.**

In Vol. IV of the *Journal* the counter-pedal surface was defined as the locus of the intersections of the normals to the ellipsoid with the diametral planes parallel to the tangent planes at each point.

In the present note it is shown that the surface so generated is also the locus of the intersections of the normals at corresponding points on the ellipsoid and its first pedal. The proposition is also shown to hold generally whatever be the primitive surface.

The counter-centro-surface of the ellipsoid is defined and its equation given. The general definition of this surface is as follows. Draw lines through a fixed point parallel to the normals to a surface; on these lines lay off distances equal in length to the radii of curvature at the corresponding point on the given surface; the locus of the points so obtained will be the counter-centro-surface.

The equation of the counter-centro-surface to the ellipsoid

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$$

is

$$\frac{a^2x^2}{Q-a^2}+\frac{b^2y^2}{Q-b^2}+\frac{c^2z^2}{Q-c^2}=0$$

where

$$Q=(a^2x^2+b^2y^2+c^2z^2)^{\frac{1}{2}}.$$

The equation when rationalized is of the eighth degree; the surface has a conjugate quadruple point at the origin, and its principal sections each consist of a conic and a sextic, viz., an ellipse and what may appropriately be called the counter-evolute to the corresponding principal section of the ellipsoid.

Article VI.—On Subinvariants, by the **Editor.**

(An abstract of this paper is printed on page 3).

Professor Cayley's important and unique memoirs on the Abelian and Theta functions, (forming the substance of his lectures delivered at the Johns Hopkins University during part of the session of 1882), will be published in the *American Journal of Mathematics*. The first three chapters have come to hand, and will appear in No. 2 of Vol. V, which it is hoped will be published sometime in the course of December.

ON SOME RECENT EXPERIMENTS IN THE CONSTRUCTION OF TELESCOPE OBJECTIVES.

By C. S. HASTINGS.

[At the request of the authorities of the University, Dr. Hastings has prepared the following account of a portion of his recent work upon the telescope].

The writer has long been interested in the theory of the construction of achromatic objectives, not only on account of the extreme elegance of many of the problems involved, but also because, notwithstanding the vast amount of work which has been expended upon them for more than a century, complete solutions had not been reached; that is to say, no objective had ever been constructed under the guidance of theory alone. Indeed, it was the assertion made to the writer by the most eminent of living telescope makers, that not only had no telescope ever been made according to theory, but that, in his opinion, none would ever be so made, which directed his attention to the subject.

From what goes before, it is evident that success was not to be hoped for by confining the effort to the mathematical aspect of the question, but, as the problem is distinctly a physical one, experiment alone could be expected to serve as an infallible guide. In short, abstract mathematical considerations could only lead to a certain conclusion, namely, that certain constants which enter the initial equations should have the same ratio as the dispersive ratio of the two varieties of glass concerned in the construction. Unfortunately, this dispersive ratio is absolutely indeterminate in all practicable cases, hence the necessity of experiment for testing the validity of any choice of a theoretical value for this ratio. The necessary preliminaries, however, were somewhat forbidding. In the first place, any theory would adapt itself to a sufficiently small objective, hence a rigid test could only be had by applying the theory to a large one; but not only would it greatly exceed the means at my disposal to have such a glass made, but, since all opticians are accustomed to work by tentative methods, it would only be possible to secure the requisite accuracy in shaping the curves by finding a skilled optician who would have faith enough in the theory to share something of its author's interest: of this, after several attempts, I despaired. It only remained then, to educate myself to this most exquisitely accurate work as a preliminary step.

A certain amount of general knowledge of the methods pursued by lens makers was acquired by visiting the various shops in this country, England, and Germany, which were readily accessible to me; to this was added the indispensable practical knowledge and dexterity for the purpose, by placing myself for a time under the instruction of a skilled optician in Paris. Then I purchased from Feil, the well known maker of optical glass a quantity of flint and crown as material upon which to experiment, deciding to make an objective of four inches aperture first. With the aims described in view, it was of the first importance to determine with all attainable accuracy the optical properties of these glasses. Prof. Becquerel kindly put at my disposal a Brunner spectrometer belonging to the *Conservatoire des Arts et Metiers*, with which a long series of measures was made upon prisms of the three varieties of glass to which the work was then restricted. The constants thus deduced were of great accuracy, but the final satisfactory values were only obtained sometime afterward with the admirable circle belonging to the physical laboratory of the Johns Hopkins University. In this investigation, the effects of variation of temperature were carefully determined and certain interesting and unexpected phenomena discovered, which formed the subject of a paper published in the *American Journal of Science.*

With the data thus acquired the curves for a four inch objective from two of the glasses studied were calculated, such that the spherical aberration for rays of mean wave length should vanish, and under the hypothesis that the sum of the squares of the chromatic aberration for other wave length, weighted according to their respective luminous intensities, should be a minimum. This was the naturally suggested criterion for determining the most advantageous value for the dispersive ratio, and, although it did not differ very greatly from the method chosen by Fraunhofer without leading to a successful issue, it was hoped that the difference would be sufficient to correct his error. The objective was carefully constructed according to these curves though it was first found necessary to improve the form of the spherometer so as to greatly increase its delicacy. The experiment proved a failure. Though the telescope was free from spherical aberration, thus proving the workmanship good, the color correction was decidedly too small. A careful remeasurement of the surfaces and a repetition of the computations demonstrated that the theory was certainly at fault.

A reconsideration of the whole subject gave rise to quite a different method of determining the most appropriate value for the dispersive ratio. By it, the question of limiting extent of chromatic aberration was not considered at all, but only a condition as to the amount of light-energy sent very near the geometrical focal image of a distant point. This theory, (*American Journal of Science*, *Vol. XI*, *April*, 1878), after having been once formulated, was so satisfactory that there was no doubt as to its success even before testing it, but, as what follows will show, that did not lead to any neglect of rigorous tests.

In accordance with curves computed on this new basis the four inch glass was again ground, polished and tested. In order to make the trial more severe the unusual ratio for focal length to aperture of 18 to 1 was chosen, as also a novel combination of surfaces by which the flint lens was brought in advance of the crown. The telescope proved an admirable one with corrections both for spherical aberration and color sensibly perfect. It has been used quite constantly since the early part of 1879 and tested by many observers; among others, by Prof. Holden, Director of the Washburn Observatory. Such objects as ξ Scorpii, ε Equilei, ζ Cancri (in 1882), η Orionis, ζ Herculis, δ Cygni, five of the satellites of Saturn even under ordinary conditions, the 5th and 6th stars of δ Orionis, and the companion to Sirius, all of which have been repeatedly seen, serve as indications of its excellence. A few even more difficult objects, which, either from exceptionally good visual powers or from not having been exhibited to others have been seen by me alone with this instrument, are not named; the list, however, contains one or two objects which have been seen, as far as I am aware, through no other telescope of the size.

Anxious to test still farther the theory, I constructed an objective of 6⅓ inches aperture of entirely different materials and curves resembling those chosen by Fraunhofer in most of his objectives. This also was made strictly in accordance with the theory and with the most gratifying results. Of interest to the optician is the fact that its focal length differed by less than $\frac{1}{10}$ of an inch from that given by calculation. The lens is now in the possession of Mr. C. H. Rockwell, at Tarrytown, N. Y., and was used by him at Honolulu in observing the last transit of Mercury. Though I have not had the opportunity for testing the telescope in astronomical work which I could wish, the ease with which I saw ζ Böotis double in 1879 (Hall 0″.55, 1878.4) and γ^2 Andromadae elongated during the same summer convinces one that it is of the highest excellence, even independently of the severe physical tests to which it had been subjected in my hands.

At the instigation of Mr. Rockwell and by means of his generous assistance, the theory was still farther tested in the construction of a larger objective of $9\frac{4}{10}$ inches clear aperture. As there are a number of novel features in this glass and several astronomers and opticians have kindly expressed an interest in the matter, it may be worth while to explain somewhat in detail its peculiarities and process of construction.

In order to secure greater latitude in choice of curves, two very thick disks were ordered from Feil, and from these pieces were cut and made into prisms. A careful study of their optical properties, made by means of the Meyerstein circle, yielded data for an elaborate investigation of the most advantageous forms for these particular varieties of glass. It is evident that the problem in this general form is an intricate one for it presents us with seven arbitrary constants, namely four radii of curvature, two thicknesses, and the distance between the two lenses. For the determination of these there are only three essential conditions to be met: a determinate focal length, proper correction for color, and freedom from aberration in light of that wave length which is to effect most strongly the sense of vision. In the ordinary treatment of the problem the last three arbitrary constants named are considered invariable, hence in such cases there remains but one condition to be imposed for the sake of making the solution determinate. In practice the condition is generally that two of the surfaces shall have the same radius of curvature, as this spares the labor on one pair of tools. In this objective, however, no such limitation was introduced, but all the latitude of choice which the seven arbitrary constants admitted was employed to determine such a form that not only would the three conditions defined be satisfied, but in addition that the spherical aberration for all other wave lengths should be a minimum, and that there should be no "ghosts," *i. e* images formed by successive reflections, near the focal plane. Of course the practical consideration was not lost sight of, that the construction should be mechanically convenient: to this end the shortest radius of curvature was arbitrarily limited to one-tenth the focal length.

The general nature of the problem rendered the solution extremely laborious, so that it was only after a year from the time of receiving the glass that the work indicated was completed. The values of the optical constants of the glass and the values finally chosen for the seven arbitrary constants are contained in the following table.

TABLE I.

Crown glass, Feil No. 1404. Sp. gr. 2.563
Flint glass, Feil No. 1406. Sp. gr. 3.516

Wave Length.	*Index ref. Crown.*	*Index ref. Flint.*
A	1.517191	1.606280
C	1.520140	1.610345
D_2	1.522814	1.615122
W. L. 5614	1.524179	1.617613
E	1.526212	1.621366
F	1.529173	1.627020
G	1.534704	1.637931
W. L. 3951	1.539698	1.648177

Flint in advance.

Radius 1st. surface, + 121.2 in.
" 2nd. " — 34.22 "
" 3rd. " + 34.48 "
" 4th. " + 106.4 "
Thickness of Flint lens, 0.862 in.
" Crown " 0.808 "
Distance between lenses from 0.1 in. upwards.

In regard to the distance between the two lenses, as the objective could readily be so mounted that this element could be varied at will through a limited extent, it was thought best to employ this feature as a means of correcting for temperature. Thus the objective is equally good, according to theory, for all temperatures between 0° and 90° Fahrenheit.

It now remained to put the solution to the practical test. Four pairs of iron tools were shaped and ground together so as to have the radii given in the table as determined by my sensitive spherometer. It is true that the most refined accuracy was unattainable at this stage, because the iron tools did not possess sufficient smoothness, but it was easy to get an approximation so close that it required but a few minutes to alter them when the smoothed glass afforded a more delicate test. While a mechanic was employed in this work a glass grinder was, with tools driven by steam, working the disks down to an approximate agreement with the required thicknesses and curvatures; then the remainder of the operations fell to my own hands. The statements as to what was done by myself shall be very specific, not merely because the following statements have impressed some skilled opticians as very surprising, but because the chief aim of this writing is to illustrate the value of the complete theoretical solution.

The order of proceeding was to grind on one surface until a most careful investigation with the spherometer after it had been "smooth" failed to detect any departure from the reading computed for its particular radius; then another surface was treated in the same way, and, so on; when all the surfaces were thus prepared for polishing, the pitch tools were constructed and the polishing *finished* for each surface in succession; then the two lenses were, one after the other, centered on a lathe and turned to like size. The method chosen for centering, as by far the most delicate, was that of a microscopic examination of reflected images while the lathe was running, the adjustments being made by means of a universal chuck, a special construction of my own. The total time occupied in these processes, starting with the glasses rough from sand grinding, was fifty hours, distributed over six days. Only after the completion of the centering was the image produced by the lens examined. There was no expectation of attaining absolute perfection in this way, as no allowance had been made for unavoidable alterations of the curves in polishing, but a very close approximation was confidently expected; and, indeed, so good was the objective that it required only twenty minutes to render it sensibly perfect.

The tests applied so far have been only such as can be derived from observing artificial stars, that is, distant points of light produced either by reflecting surfaces of great curvature in sunshine, or by transmitting light through small holes in an opaque screen; but, as is well-known, these are of great delicacy. The tests were as follows:

I. It was found that the probable error of focussing with an ocular, giving a power of a little more than 800, was less than $\frac{1}{100}$ of an inch.

II. When the light was modified by absorption through a piece of yellow glass so as to reduce the effect of secondary dispersion, a high power ocular moving inwards or outwards showed the central disk expanding and exhibiting successively a dark and then a bright disk at the center. This periodic change could be traced on either side of the focal plane until lost by the faintness of the image: it proves to a marvellous degree of precision that the spherical aberration was perfectly corrected. In very many examinations it has never been my fortune to see this degree of excellence in any other large objective.

III. As I had intended visiting Cincinnati at the time of the meeting of the American Association last year, and to give the substance of my experiments there, the lens was sent to the Exhibition of the Ohio Mechanics Institute. As it was regularly entered, it was tested by Prof. Stone, then Director of the Cincinnati Observatory, and Profs. Warder and Wilson, and, at their recommendation, accorded the highest award offered by the society.

Of course the most satisfactory test of the performance of an astronomical objective consists in using it for astronomical work; but this test has been wanting hitherto because I have not been able to provide the lens with the necessary tube and stand.

Since the telescope objectives named are far better known as regards their optical constants than any others in existence the more interesting of them are appended for the $9\frac{4}{10}$ inch. The list shows at once the character of the color correction and of the correction for spherical aberration, though it is to be observed that these numbers are the result of computation, not of measurement; the relation of the color correction, however, to that which characterizes some of the best large telescopes by prominent makers is fully discussed in the paper, cited above, where the theory of this correction is developed.

TABLE II.

Values of the distances from the vertex of first surface to focal planes, for an interval of 0.25 in. between the lenses, at a temperature of 20° C.

Wave Length.	*Central Rays.*	*Marginal Rays.*	*Spherical Aberration.*	*Marginal Chromatic Aberration.*
A	142.1002 in.	142.0838 in.	+ 0.0165 in.	+ 0.1892 in.
C	141.9622 "	141.9501 "	.0119 "	.0555 "
D_2	141.9005 "	141.8954 "	.0050 "	.0008 "
W. L. 5614	141.8948 "	141.8946 "	+ .0002 "	.0000 "
E	141.9027 "	141.9073 "	— .0046 "	.0127 "
W. L. 5000*	141.9438 "	141.9582 "	.0144 "	.0636 "
F	141.9892 "	142.0058 "	.0166 "	.1112 "
G	142.2948 "	142.3335 "	.0387 "	.4389 "
W. L. 3951	142.7386 "	142.7968 "	— .0583 "	.9022 "

For ray of W. L. 5614 at ⅔ distance from centre to margin, 141.8948 in.

This account will demonstrate that the problem has been finally solved. It is clear that the value of the solution increases with the dimensions of the objective to which it is applied, and for that reason it was tested on as large a scale as possible at the time, but this limit was set by no want of confidence or lack of desire to attempt the largest size for which the glass makers are prepared to furnish material.

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*For this value the index of refraction for the Flint only was measured, that for the Crown being computed from this.

Note on Mr. E. A. Freeman's Remarks on Trial by the Court in Criminal Cases.

(Reprinted from "The Nation," N. Y., October 12, 1882).

To the Editor of the Nation:

SIR: Mr. Edward A. Freeman, in a recent article in the *Fortnightly Review*, entitled "Some Impressions of the United States," makes the following statement, which seems to require explanation: "New devices, indeed, we sometimes light upon in the New World. When we look at a Maryland judge, who is authorized under certain circumstances to send men to the gallows without a jury, we are divided between wonder at the innovation and awe toward a being who can do what no being that we ever saw before can do."

The innovation in Maryland which creates wonder and awe in the mind of Mr. Freeman, is a law which gives to every one accused of crime the right to elect whether he will be tried by a Court or a jury, without excepting capital cases. It has in substance been in force ever since 1793, and is entirely satisfactory to the people of the State. It is very seldom that capital cases are submitted to the Court, although instances have occurred, but in none, as far as I know, has the Court found it necessary to pronounce sentence of death.

It is a noteworthy fact, however, that those accused of all other offences generally prefer the Court to a jury. I have before me a list of the trials which took place in the Criminal Court of Baltimore City from the first of January, 1880, to the eleventh of September, 1882. They were in all 4,417. Of these, many were police cases, which are everywhere tried without a jury, but a large number were crimes of the grade of felony, which, according to the rules of the common law, could only be tried before a jury. In the trial of all these cases, only 238 juries were sworn. This Court is presided over by a single judge, and during the last fifteen years the presiding judge has been changed three times, but throughout the entire period the trials by the Court of offences of every grade, less than capital, have greatly exceeded those by a jury. A very onerous, and often painful, duty is thus imposed on the Court, but it is easy to see that much is gained in saving expense, as well as the time of all concerned in the trials. If it be right to give to the accused the privilege of election to be tried by the Court or a jury, there seems to be no sufficient reason to deprive him of it in a capital case.

The law of Maryland is at least worthy of consideration by those communities which do not permit any one accused of felony to be tried by the Court, but subject him against his will to the tedious, expensive, and uncertain trial by jury.

G. W. B.

BALTIMORE, *October* 7, 1882.

INTRODUCTORY LECTURE ON THE STUDY OF LOGIC.

[*Outline of the Remarks made by* PROF. C. S. PEIRCE, *at the beginning of his Course, September*, 1882].

Professor C. S. Peirce began his instruction for the current session by a lecture in Hopkins Hall, on the underlying methods of modern logic. It was attended by instructors as well as students. In compliance with a request for an abstract of his address, which was delivered without notes, the speaker has given the following outline.

Mr. Peirce said that he had requested the instructors to do him the favor to listen to his observations, because he thought that a clear understanding of the purpose of the study of logic might remove some prejudices by leading to a true estimate of its nature.

It might be supposed that logic taught that much was to be accomplished by mere rumination, though every one knows that experiment, observation, comparison, active scrutiny of facts, is what is wanted, and that mere *thinking* will accomplish nothing even in mathematics. Logic had certainly been defined as the "art of thinking," and as the "science of the normative laws of thought." But those are not true definitions. "*Dyalectica*," says the logical text-book of the middle ages, "*est ars artium et scientia scientiarum, ad omnium aliarum scientiarum methodorum principia viam habens*," and although the logic of our day must naturally be utterly different from that of the Plantagenet epoch, yet this general conception that it is the *art of devising methods of research*,—the *method of methods*,—is the true and worthy idea of the science. Logic will not undertake to inform you what kind of experiments you ought to make in order best to determine the acceleration of gravity, or the value of the Ohm; but it will tell you how to proceed to form a plan of experimentation.

It is impossible to maintain that the superiority of the science of the moderns over that of the ancients is due to anything but a better *logic*. No one can think that the Greeks were inferior to any modern people whatever in natural aptitude for science. We may grant that their opportunities for research were less; and it may be said that ancient astronomy could make no progress beyond the Ptolemaic system until sufficient time had elapsed to prove the insufficiency of Ptolemy's tables. The ancients could have no dynamics so long as no important dynamical problem had presented itself; they could have no theory of heat without the steam-engine, etc. Of course, these causes had their influence, and of course they were not the main reason of the defects of the ancient civilization. Ten years' astronomical observations with instruments such as the ancients could have constructed would have sufficed to overthrow the old astronomy. The great mechanical discoveries of Galileo were made with no apparatus to speak of. If, in any direction whatever, the ancients had once commenced research by right methods, opportunities for new advances would have been brought along in the train of those that went before. But read the logical treatise of Philodemus; see how he strenuously argues that inductive reasoning is not utterly without value, and you see where the fault lay. When such an elementary point as that needed serious argumentation it is clear that the conception of scientific method was almost entirely wanting.

Modern methods have created modern science; and this century, and especially the last twenty-five years, have done more to create new methods than any former equal period. We live in the very age of methods. Even mathematics and astronomy have put on new faces. Chemistry and physics are on completely new tracks. Linguistic, history, mythology, sociology, biology, are all getting studied in new ways. Jurisprudence and law have begun to feel the impulse, and must in the future be more and more rapidly influenced by it.

This is the age of methods; and the university which is to be the exponent of the living condition of the human mind, must be the university of methods.

Now I grant you that to say that this is the age of the development of new methods of research is so far from saying that it is the age of the theory of methods, that it is almost to say the reverse. Unfortunately practice generally precedes theory, and it is the usual fate of mankind to get things done in some boggling way first, and find out afterward how they could have been done much more easily and perfectly. And it must be confessed that we students of the science of modern methods are as yet but a voice crying in the wilderness, and saying prepare ye the way for this lord of the sciences which is to come.

Yet even now we can do a little more than that. The theory of any act in no wise aids the doing of it, so long as what is to be done is of a narrow description, so that it can be governed by the unconscious part of our organism. For such purposes, rules of thumb or no rules at all are the best. You cannot play billiards by analytical mechanics nor keep shop by political economy. But when new paths have to be struck out, a spinal cord is not enough; a brain is needed, and that brain an organ of mind, and that mind perfected by a liberal education. And a liberal education—so far as its relation to the understanding goes—means *logic*. That is indispensable to it, and no other one thing is.

I do not need to be told that science consists of specialties. I know all that, for I belong to the guild of science, have learned one of its trades and am saturated with its current notions. But in my judgment there are scientific men, all whose training has only served to belittle them, and I do not see that a mere scientific specialist stands intellectually much higher than an artisan. I am quite sure that a young man who spends his time exclusively in the laboratory of physics or chemistry or biology, is in danger of profiting but little more from his work than if he were an apprentice in a machine shop.

The scientific specialists—pendulum swingers and the like—are doing a great and useful work; each one very little, but altogether something vast. But the higher places in science in the coming years are for those who succeed in adapting the methods of one science to the investigation of another. That is what the greatest progress of the passing generation has consisted in. Darwin adapted to biology the methods of Malthus and the economists; Maxwell adapted to the theory of gases the methods of the doctrine of chances, and to electricity the methods of hydrodynamics. Wundt adapts to psychology the methods of physiology; Galton adapts to the same study the methods of the theory of errors; Morgan adapted to history a method from biology; Cournot adapted to political economy the calculus of variations. The philologists have adapted to their science the methods of the decipherers of dispatches. The astronomers have learned the methods of chemistry; radiant heat is investigated with an ear trumpet; the mental temperament is read off on a vernier.

Now although a man needs not the theory of a method in order to apply it as it has been applied already, yet in order to adapt to his own science the method of another with which he is less familiar, and to properly modify it so as to suit it to its new use, an acquaintance with the principles upon which it depends will be of the greatest benefit. For that sort of work a man needs to be more than a mere specialist; he needs such a general training of his mind, and such knowledge as shall show him how to make his powers most effective in a new direction. That knowledge is logic.

In short, if my view is the true one, a young man wants a physical education and an aesthetic education, an education in the ways of the world and a moral education, and with all these logic has nothing in particular to do; but so far as he wants an intellectual education, it is precisely logic that he wants; and whether he be in one lecture-room or another, his ultimate purpose is to improve his logical power and his knowledge of methods. To this great end a young man's attention ought to be directed when he first comes to the university; he ought to keep it steadily in view during the whole period of his studies; and finally, he will do well to review his whole work in the light which an education in logic throws upon it.

I should be the very first to insist that logic can never be learned from logic-books or logic lectures. The material of positive science must form its basis and its vehicle. Only relatively little could be done by the lecturer on method even were he master of the whole circle of the sciences. Nevertheless, I do think that I can impart to you something of real utility, and that the theory of method will shed much light on all your other studies.

The impression is rife that success in logic requires a mathematical head. But this is not true. The habit of looking at questions in a mathematical way is, I must say, of great advantage, and thus a turn for mathematics is of more or less service in any science, physical or moral. But no brilliant talent for mathematics is at all necessary for the study of logic.

The course which I am to give this year begins with some necessary preliminaries upon the theory of cognition. For it is requisite to form a clear idea at the outset of what knowledge consists of, and to consider a little what are the operations of the mind by which it is produced. But I abridge this part of the course as much as possible, partly because it will be treated by other instructors, and partly because I desire to push on to my main subject, the method of science.

I next take up syllogism, the lowest and most rudimentary of all forms of reasoning, but very fundamental because it is rudimentary. I treat this after the general style of DeMorgan, with references to the old traditional doctrine. Next comes the logical algebra of Boole, a subject in itself extremely easy, but very useful both from a theoretical point of view and also as giving a method of solving certain rather frequently occurring and puzzling problems. From this subject, I am naturally led to the consideration of relative terms. The logic of relatives, so far as it has been investigated, is clear and easy, and at the same time it furnishes the key to many of the difficulties of logic, and has already served as the instrument of some discoveries in mathematics. An easy application of this branch of logic is to the doctrine of breadth and depth or the relations between objects and characters. I next introduce the conception of number, and after showing how to treat certain statistical problems, I take up the doctrine of chances. A very simple and elegant mathematical method of treating equations of finite differences puts the student into possession of a powerful instrument for the solution of all problems of probability that do not import difficulties extraneous to the theory of probability itself.

We thus arrive at the study of that kind of probable inference that is really distinctive; that is to say, Induction in its broadest sense—Scientific Reasoning. The general theory of the subject is carefully worked out with the aid of real examples in great variety, and rules for the performance of the operation are given. These rules have not been picked up by hazard, nor are they merely such as experience recommends; they are deduced methodically from the general theory.

Finally, it is desirable to illustrate a long concatenation of scientific inferences. For this purpose we take up Kepler's great work, *De Motu Stellae Martis*, the greatest piece of inductive reasoning ever produced. Owing to the admirable and exceptional manner in which the work is written, it is possible to follow Kepler's whole course of investigation from beginning to end, and to show the application of all the maxims of induction already laid down.

In order to illustrate the method of reasoning about a subject of a more metaphysical kind, I shall then take up the scientific theories of the constitution of matter.

Last of all, I shall give a few lectures to show what are the lessons that a study of scientific procedure teaches with reference to philosophical questions, such as the conception of causation and the like.

THE UNIVERSITY OF LONDON.

[*Abstract of an opening address at the Johns Hopkins University, by W. B. Carpenter, F. R. S., LL. D*].

At the opening assembly of the Officers and Students of the Johns Hopkins University for the present academic year, September 26, 1882, Dr. W. B. Carpenter, F. R. S., for many years Registrar of the University of London, was present by invitation of the Trustees, and made a brief address. The following abstract of it has been prepared and has received his revision.

Dr. Carpenter said: I cannot but feel diffidence in a position which has been occupied by some of my distinguished friends, such as Dean Stanley, Prof. Huxley, and others, who have before addressed the members of this University. But I could not refuse the request made to me by your President, that I should give you a sketch of the history of the University of London; an institution with which I have been officially connected, in one capacity or another, for more than thirty years, and my experience of which (he assures me) is likely to be both interesting and valuable to you.

After this introduction, Dr. Carpenter proceeded to say, that about fifty years ago the early education of the upper classes in England was mostly carried on in the great Public Schools, whose curriculum of study consisted almost entirely of the Classics; so little attention being paid even to Mathematics, that, when the University of London was established, it was found that the entrance examination could not include more than the first book of Euclid. As an illustration of the slight knowledge the youths had even of Arithmetic, Dr. Carpenter related an anecdote told him by Prof. Key, who in his earlier life had many private pupils, among whom was one from the sixth form at Eton. The latter, while walking one day with the professor, expressed a desire to buy some silk stockings. He went into a store; the price was 7s.; he wanted six pairs of them, and to find the entire cost, went through the laborious process of adding seven to seven, adding seven more, and so on. The Professor, astonished, asked him if he had ever seen a multiplication table, and received a negative answer. When the young man found out that there was such a thing, he was so delighted that he learned the whole table in two days.—There were small private schools, some of them of great excellence; but the large public schools prepared the great bulk of the students for the Universities.

Now, the two older Universities are extremely peculiar, with their old traditions, and their monastic and scholastic discipline. The buildings are beautiful, and the surroundings such that a lasting attachment to their Alma Mater is felt by those who have gone through these Universities. At Cambridge, higher mathematical education was a specialty, while at Oxford the classics were especially insisted upon. No one could then *enter* Oxford who would not sign the thirty-nine articles; this affected the morality of the institution; and Dr. Carpenter related the instance of a man who had unknowingly signed them, thinking he was putting his name in the porter's book. At Cambridge anyone might enter, but could not take the degree unless he could sign. He could, however, be "placed" in the Honors list; as had been the case with Professor Sylvester. The speaker then explained the method of instruction employed, and also that of the Scotch Universities, where, while there was no religious test required of students, there was for professorships, which prevented himself from becoming a professor, as he otherwise would. Then the "London University" was established by a joint stock company, through the efforts of some members of the Liberal party. Every chair was represented, except theology; at first not even moral philosophy was tolerated, but this was finally smuggled in under the name of "the History of Ethical Theories;" and the medical school proved a great success, its course of instruction being much superior to that given in the Hospital Schools of London, on which it soon exerted an elevating influence. The speaker then detailed the steps which led to the institution of the *real* University of London; a body nominated by the Crown, which has the power of conferring degrees, and regulating the curriculum of study for them, but which does not itself engage in the work of teaching. It receives its candidates from University College (the original London University) and Kings College, London, from the Medical Schools of London and the Provinces, and from numerous Dissenting and Catholic Colleges throughout the kingdom, and also—except as regards Medicine—from private study. The basis of its curriculum is the Matriculation examination, which tests a thoroughly good school education; and this requirement has done much to raise the value of its degrees; no one being able to enter upon his University curriculum in either of the Faculties, without passing this. The University of London was the first British University to institute Degrees in Science; and the curriculum in that Faculty was framed on the principle laid down by Faraday (then a member of its Senate), which was that the degree of Bachelor should attest the possession of a broad, general, scientific culture, whilst the degree of Doctor (held by Dr. Martin) should be given upon the basis of the B. Sc., for *very high* proficiency in some *special* department of scientific study. The two causes which have led to the success of the University of London are, first, its independent position as to the standard required, as shown in the proportion of plucks; and, second, its freedom in the choice of examiners. No one has the least pocket-interest in this University, while others are afraid to raise their standard; and its Examinerships have been held by the foremost men in every department of knowledge. Concerning the relation between the University of London and the Johns Hopkins, Dr. Carpenter said that it had been the principle of the former that it should not take any part in teaching; but of late years it had been under consideration whether there ought not to be engrafted upon it a system of higher education; and he learned with satisfaction the great work that is being done here, in addition to ordinary university study, in attracting graduate students from other colleges—a work in which he took a great interest. Dr. Carpenter further said that he met here with elements for greater progress than in any institution with which he was acquainted; that its highly elastic constitution and the freedom of the trustees gave it great power of expansion, and that he was amazed into how extensive a field its scholarship had extended.

In conclusion, Dr. Carpenter said that England was not so rotten an old country, after all; its progress in many respects during the last fifty years being one which America might well profit by. He then spoke of our civil service, showing a keen insight into the evils which beset us, and dwelling upon the necessity of the formation of an intelligent public opinion. He was glad to see a co-operation of good men of both political parties, who were coming forward to remove the dark spot which stains our service. He said he could not wish us anything better than that a system should be introduced here, which should bring about equally good results as that produced by the adoption of the present English system.

HOPKINS HALL LECTURES.

Notice in Respect to the Admission of the Public.

In answer to inquiries, and in correction of some current misapprehensions, the following statements are made in respect to the courses of lectures annually given in the Johns Hopkins University.

1. These courses are academic lectures, designed primarily for the members of the University, and supplementary to the regular class-room work of the students.

2. As the members of the University rarely require the entire room, the Trustees have taken great pleasure in inviting other persons, not connected with the University, to attend.

3. As these lectures are not intended for popular entertainment, but for the instruction of students, those persons first receive tickets, in most cases, who are known to be especially interested in a particular course,—ladies as well as gentlemen. Preference is thus given, according to the character of the course, to teachers in other institutions, public and private; students of medicine, law, etc.; professional men, and others. If any tickets remain undistributed, they are given out to those who may have applied for them, in order of application.

4. The hall is full when 200 hearers are present; it is uncomfortable if more are admitted. Not infrequently two or three times that number of persons apply for admission and often applications for tickets cannot be granted. To give the lectures elsewhere would alter their character as a part of the ordinary academic work of the University.

5. *There is no general course ticket issued.* Programmes and other current information pertinent to university work may be found in the *University Circulars*, sent to subscribers on the payment of one dollar per annum, either by Messrs. Cushings & Bailey, or by the University.

6. It will save much delay if inquiries on these and other routine matters are addressed not to individuals but to the Johns Hopkins University, *by postal card*, and answers will be promptly returned by mail. Personal applications consume time needlessly.

☞ The lectures begin at 5 o'clock *punctually*. The doors of the hall are opened at fifteen minutes before 5, and the lectures do not exceed an hour in the delivery.

PROGRAMME OF LECTURES, SESSION 1882-3.

I.

NEW TESTAMENT AND PATRISTIC GREEK.

J. Rendel Harris, M. A. (Cantab.), Fellow, and late Librarian and Lecturer of Clare College in the University of Cambridge.

1. Introductory to the Critical Study of the Greek Testament. Six lectures, October 24 to November 9.

2. Epistle to Diognetus. Five lectures, Tuesdays and Thursdays, November 14 to 28.

The Epistle will be discussed somewhat in the following order:

Introduction—Translation—Authorship; should it be referred to Justin, Melito, Apollinaris, or some other leading thinker of the early Church—Doubtful character of the last two chapters of the Epistle—The Agapæ in the early Church—Side-lights on the relations between the modes of thought in the early Church and in the world at large—Persistence of the gift of prophecy in the early Church, etc.

The text will be read in an English version and elucidated by comments. A translation of the Epistle is given in the first volume of the Early Christian Literature Primers, by Rev. G. A. Jackson, (18mo., Appleton, N. Y.). A copy of the Greek text may be found appended to Professor Gildersleeve's edition of Justin Martyr (12mo., N. Y., 1877).

II.

OLD NORSE LITERATURE.

W. H. Carpenter, (Ph. D., University of Freiburg), Fellow by Courtesy. Twelve lectures, on the Eddas, etc., Mondays and Fridays, November 10 to December 22.

Special Subjects and Books of Reference.

I. The Ancient Literature of the Scandinavian North. Its historical development. Historical review: Denmark, Sweden, Norway, the British Islands, the Faroes, Iceland, Greenland, Vinland.

Otté, E. C. Scandinavian History. *London*, (*Macmillan*), 1874. (H). (P).

II. Iceland. Its discovery and settlement and a short review of its history.

Maurer, K. Island von seiner ersten Entdeckung bis zum Untergange des Freistaats. *München*, 1874. (P.) Maurer, K. Die Entstehung des Isländischen Staats und seiner Verfassung. *München*, 1852. (P). Dasent, G. W. The Norsemen in Iceland. (*Oxford Essays*, 1858). (P).

III. Old Norse Literature. The Eddas; other poetical literature. The Sagas; other prose literature.

Vigfusson, G. Sturlunga Saga. 2 Vols. *Oxford*, 1878. (Vol. I., Prolegomena). (H). (P). Horn, F. W. Geschichte der Literatur des Skandinavischen Nordens. *Leipzig*, 1880. (H). (P).

IV. The Elder or Sæmundar Edda. Its age and author. What it contains.

Thorpe, B. The Edda of Sæmund the Learned. *London*, 1866. Simrock, K. Die Edda. *Stuttgart*, 1878. (H). (P). Wenzel, B. Die Aeltere Edda. Leipzig, 1877. (H).

V. The Elder Edda. The mythical and ethical lays of the Edda.

Anderson, R. B. Norse Mythology. *Chicago*, 1875. (P). Holtzmann, A. Deutsche Mythologie. *Leipzig*, 1874. (H). Simrock, K. Handbuch der Deutschen Mythologie. *Bonn*, 1878. (H). (P).

VI. The Elder Edda. The heroic lays of the Edda: the Lays of Helgi; Sigurd the Volsung and the Ring of the Nibelungs.

Magnusson & Morris. The Story of the Volsungs and Nibelungs, with certain Songs from the Elder Edda. *London*, 1870. (P). Morris, Wm. The Story of Sigurd the Volsung and the fall of the Nibelungs. *Boston*, 1881. (P). Bergmann, F. W. Die Edda-Gedichte der Nordischen Heldensage. *Strassburg*, 1879. (P).

VII. The Elder Edda. Sigurd the Volsung and the Nibelungs, *Continued*. The Nibelungen Lied.

VIII. The Younger or Snorra Edda. Its age and author. What it contains.

Anderson, R. B. The Younger Edda. *Chicago*, 1880. (H). Mallet-Percy-Blackwell. Northern Antiquities. (Bohn's Library). *London*, 1859. (P). Simrock, K. Die Edda. *Cited above*. Bergmann, F. W. La Fascination de Gulfi. *Strassburg*, 1871. (H). (P).

IX. Other Poetical Literature. The Skalds and their poems. Later poetry.

X. The Sagas. Mythic-heroic Sagas.

Magnusson & Morris. The Story of the Volsungs and Nibelungs: Völsunga Saga. *Cited above*.

XI. The Sagas. Historical Sagas.

Dasent, G. W. The Story of Burnt Njal. *Edinburgh*, 1861. (H). (P). Other English translations of the Sagas are: Magnusson & Morris. Three Northern Love Stories and other Tales. *London*, 1875. (P.) *do. do.* The Story of Grettir the Strong. *London*, 1869. (P). Head, E. The Story of Viga-Glum. *London*, 1866. (P). Dasent, G. W. The Story of Gisli the Outlaw. *Edinburgh*, 1866. (P.) Anderson, R. B. Viking Tales of the North. *Chicago*, 1878. (P).

XII. Old Norse Historical Literature. The Historians: Ari; Sturla; Snorri.

Laing, S. The Heimskringla. *London*, 1844. (P).

Note.—A complete Old Norse bibliography is contained in: Möbius, Th. Catalogus Librorum Islandicorum et Norvegicorum Ætatis Mediæ. *Leipzig*, 1856; and in: Verzeichniss der auf dem Gebiete der Altnordischen Sprache und Literatur erschienen Schriften. *Leipzig*, 1880.

A bibliographical list of the living authors of Iceland is now in course of publication in the Bulletin of "The Library of Cornell University."

Books marked (H) are in the Johns Hopkins University Library; (P) in the Library of the Peabody Institute.

III.

FRENCH LITERATURE.

M. **Rabillon**, Lecturer on French Literature. Lectures (*in French*), Saturdays, after November 4.

First Seven Lectures—to Dec. 16.

The special subject considered will be The Expression of Paternal Affection in the Classic and Modern French Writers—Corneille, Racine, Molière, Balzac, and Victor Hugo. The following works will be taken up in successive lectures:

Corneille:—*Les Horaces; Le Cid; Le Menteur;*
Molière:—*L'avare; Le festin de pierre;*
(General considerations upon Molière in connection with the principal subject of the course.)
Victor Hugo:—*Le roi s'amuse.*

Persons intending to follow the course are advised to procure the above-named works.

The second series of lectures will begin early in January.

IV.

POLITICAL SCIENCE.

Richard T. **Ely**, (Ph. D., Heidelberg), Associate in Political Economy. Six lectures on *French and German Socialism*, Tuesdays and Thursdays, December 5 to 21.

The special topics taken up will be:

I. The Laboring Classes and the French Revolution.
II. St. Simon and the French Socialists.
III. Carl Marx and the International.
IV. Ferdinand Lassalle and the "Iron Law of Wages."
V. Social Democracy and Revolution.
VI. Socialism of the Chair and Christian Socialism.

V.

ETCHERS AND ETCHING.

Mr. F. **Seymour Haden**, F. R. C. S., of London. Three lectures, Tuesday, Wednesday, and Thursday, January 2, 3, 4.

The following subjects will be treated:

I. The Principles of Etching.
II. The Practice of Etching.
III. The Great Masters of Etching.

The course will be illustrated by diagrams and examples.

An article, by Mr. Philip Gilbert Hamerton, on Mr. Haden's Etchings may be found in Scribner's Monthly for August, 1880.

Particulars in regard to the following courses will be given later:

I. *Philosophy*. **Professor George** S. **Morris** Eight lectures, Mondays and Tuesdays, January 8 to 30.

II. *English Literature* (3 courses).

1. **Professor Hiram Corson**, of Cornell University. Ten lectures, Wednesdays, Thursdays, and Fridays, January 10 to 31.

2. **Professor James** A. **Harrison**, of Washington and Lee University. Ten lectures, Mondays, Wednesdays, and Fridays, February 12 to March 2.

3. **Mr. George** W. **Cable**, of New Orleans. Six lectures, Mondays, Wednesdays, and Fridays, March 5 to 16.

PEABODY INSTITUTE LECTURES.

A general course of thirty lectures will be given in Peabody Hall, every Tuesday and Thursday evening at 8 o'clock, from November 7 till March 1, with a recess of two weeks at Christmas. *The references to books are for a short course of reading in connection with the lectures. All books referred to are in the Peabody Library.*

(Reprinted from the Peabody Institute Calendar for 1882-3).

I. **Mr. George** M. **Towle**, of Boston. Six lectures, Nov. 7, 9, 14, 16, 21, 28, on *Famous Men and Women of our Day*.

1. Queen Victoria; 2. Czar and Nihilists; 3. John Bright; 4. Empress Eugenie; 5. Thomas Carlyle; 6. Victor Hugo.

References.—Queen Victoria's Our Life in the Highlands; Martin's Prince Consort; McCarthy's History of Our Own Times; For Nihilists, see Internat. Rev., vol. VIII, p. 372; and vol. X, 349, 411, 594, Contemp. Rev., vol. 38, 913 and for May, 1882; Smith's Life of Bright; Bright's speeches; Baree's Prince Imperial, and Jerrold's Napoleon III; Froude's, Shepherd's, Wylie's, Nichols's and Wilson's Carlyle; Froude's Reminiscences of Carlyle; Barbou's Victor Hugo, and Internat. Rev., vol. XI, 283, 391.

II. **Mr. Horace** E. **Scudder**, of Cambridge, Mass., author of the "Bodley" books and other works for children. Four lectures, Nov. 28, 30, Dec. 5, 7, on *Childhood in Literature and Art*.

1. Childhood before and after Christ; 2. Childhood in English Literature and Art; 3. Childhood in the Nineteenth Century; 4. Childhood in Literature, and Literature for Childhood.

III. **Prof. Moses Coit Tyler**, of Cornell University, author of "A History of American Literature." Four lectures, Dec. 12, 14, 19, 21, on *Some Phases of the Intellectual History of America in the 17th and 18th Centuries*.

1. Our Earliest Colleges—their Founders, their Students, their Work, their Play; 2. Leading Ideas in Physical Science as held by our Colonial Fathers; 3. Bishop Berkeley—his Visit to America in 1729-1731, and its Effect on Higher Education; 4. The Literary Services of Thomas Paine in the American Revolution.

References.—Lodge's Short History of the English Colonies; Tyler's History of American Literature, 1607-1765; Quincy's History of Harvard University; The Harvard Book; The Yale Book; Fraser's Life of Bishop Berkeley; References to Thomas Paine in Bancroft's, Hildreth's, and Bryant's Histories of the United States.

IV. **Mr. Franklin** B. **Hough**, Chief of Forestry, Department of Agriculture, Washington. Four lectures, Jan. 9, 11, 16, 18, on *Forestry*.

1. Natural Distribution of Forests: Effects of Latitude, Altitude, Aspect, Soil, &c., and to what extent we may take Advantage of those in the Cultivation of Woodlands; 2. The Sanitary and Climatic Influences of Forests; 3. Effects of Denudation: Examples of Excessive Clearing and the Dangers Threatened; 4. The Restoration of Forests: Planting under Difficulties as on Dunes, Sandy Wastes, and Mountains eroded by Torrents.

References.—Marsh's Man and Nature, and his Earth as Modified by Human Action; Emerson's Trees of Massachusetts; Hough's Elements of Forestry, and his Reports on Forestry; Brown's Forester; Laslett's Timber and Timber Trees.

V. **Prof. Henry** E. **Shepherd**, President of the College of Charleston, S. C. Two lectures, Jan. 23, 25, on *English Literature*.

1. The English of the Elizabethan Age; 2. Modern English, its Growth and Character.

References.—Abbott's Grammar of Shakspeare, introductory chapter; Craik's English of Shakespeare; Encyclopedia Britannica, 9th Edition, vol. VIII, article English Language; Hall's Modern English; Shepherd's History of the English Language, chaps. 25, 26, 27, 28; Oliphant's Sources of Standard English—the closing chapter and Specimens.

VI. **Dr. Herbert** B. **Adams**, Associate Professor of History, Johns Hopkins University. Four lectures, Jan. 30, Feb. 1, 6, 8, on *Local Life and Home Institutions*.

1. The Aryan Village in the Old World and the New; Plantations, North and South; 2. The English Parish in America; Tithings, Hundreds, Manors, Counties; 3. Northern Towns and Southern Boroughs; Baltimore-Town; 4. Townships and Common Schools, West and South; Ideas of Jefferson and Peabody.

References.—Coulanges's Cité Antique; Maine's Village Communities; Hearn's Aryan Household; Phear's Aryan Village; Taine's Notes on England, chap. 11; Escott's England, chap. 2; Olmsted's Cotton Kingdom, and his Journeys; Jefferson's Works, vol. VII, pp. 13, 35; John Adams's Works, vol. II, p. 182, and vol. V, p. 495; Peabody Education Fund Reports; Shires and Shire Towns in the South, in Lippincott's Magazine, August, 1882.

VII. **Prof. Charles** A. **Young**, of the College of New Jersey, author of "The Sun." Four illustrated lectures, Feb. 13, 15, 20, 22, on *Astronomy*.

1. Astronomical Dimensions and their Measurement, (special reference to the Transit of Venus); 2. Recent Investigations in Solar Physics; 3. The Planetary System as at present known; 4. Meteors and Comets.

References.—Newcomb's Popular Astronomy, 3d edition; Proctor's Other Worlds than Ours; Lockyer's Studies in Spectrum Analysis; his Lectures on Solar Physics, in Nature, vol. XXIV; Young's The Sun; Siemen's New Theory of the Sun, in Nineteenth Century for April, 1882.

VIII. **Rev.** A. D. **Mayo**, of Washington, Agent in the South of the Education Society. Two lectures, Feb. 27, March 1, on *The New Education in the South*.

1. The Helping Hand from Abroad; 2. The Up-building at home.

References.—Reports of the Bureau of Education, and those of the Peabody Education Fund.

ENUMERATION OF CLASSES, FIRST HALF-YEAR, 1882-83.

Mathematics. (38 Students).

Classes meet in Room 16.

Theory of Substitutions: Professor Sylvester. Twice weekly, Tuesday and Friday, 4 P. M. (9).

Bissing.
Collins, J. V.
Craig.
Davis.
Durfee.
Ely, G. S.
Franklin.
Hathaway.
Story.

Analytic Geometry: *Advanced Course:* Dr. Story. Three times weekly, Tuesday, Wednesday, and Friday, 10 A. M. (6).

Barnes.
Bissing.
Collins, J. V.
Davis.
Durfee.
Ely, G. S.

Higher Plane Curves: *Elementary Course:* Dr. Story. Three times weekly, Monday, Wednesday, and Thursday, 1 P. M. (3).

Hathaway.
Schuermann.
Taber.

Elliptic Functions: Dr. Craig. Three times weekly, Tuesday, Wednesday, and Friday, 11 A. M. (10).

Barnes.
Bissing.
Collins, J. V.
Davis.
Durfee.
Ely, G. S.
Hathaway.
Schuermann.
Taber.
Veblen.

Definite Integrals: Dr. Craig. Twice weekly, Monday and Thursday, 10 A. M. (2).

Barnes.
Hathaway.

Mechanics: Dr. Craig. Three times weekly, Monday, Tuesday, and Thursday, 12 M. (4).

Collins, J. V.
Kimball.
Reid.
Schuermann.

Calculus of Variations: Dr. Craig. Twice weekly, Wednesday and Friday, 9 A. M. (6).

Barnes.
Goodnow.
Hathaway.
Schuermann.
Taber.
Veblen.

Determinants: Dr. Franklin. Daily, 4 P. M. (9).

Barnes.
Brace.
Howe.
Kimball.
Nixon.
Perkins, C. A.
Perkins, W. H.
Veblen.
Witzenbacher.

(This course was concluded in October).

Differential and Integral Calculus: Dr. Franklin. Daily, 11 A. M. (12).

Artz.
Carroll.
De Witt.
Faerber.
Gilbert.
Howe.
Huggins.
Lyons.
Morrill.
Nixon.
Scott.
Wiegand.

Solid Analytic Geometry: Dr. Franklin. Three times weekly, Tuesday, Thursday, and Friday, 10 A. M. (6).

Howe.
Nixon.
Perkins, W. H.
Veblen.
Williams, H. W.
Witzenbacher.

Physics. (49 Students).

Classes meet in Rooms 3, 4, 7, 8.

Electricity and Magnetism: Professor Rowland. Four times weekly, Monday, Tuesday, Wednesday, and Friday, 3 P. M. (12).

Brace.
Collins, J. V.
Duncan.
Goodnow.
Hathaway.
Kimball.
Koyl.
Liebig, G. A.
Morrill.
Perkins, C. A.
Reid.
Schuermann.

Laboratory Work: Professor Rowland. Daily. (10 advanced students).

Brace.
Finley.
Goodnow.
Kimball.
Koyl.
Liebig, G. A.
Morrill.
Perkins, C. A.
Reid.
Russell.

Major Course: Dr. Hastings. Lecture, once weekly, Thursday, 3.30 P. M.; Laboratory work daily, especially Wednesday. (15).

Brace.
Collins, J. V.
Davis.
Day, D. T.
Duncan.
Durfee.
Ely, G. S.
Hall.
Howe.
Keiser.
Kimball.
Morrill.
Reid.
Schubart.
Schuermann.

General Physics: *Minor Course:* Dr. Hastings. Daily, 10 A. M. (27).

Artz.
Baker.
Bayley.
Boston.
Campbell.
Carey.
Carroll.
Crum.
De Witt.
Fels.
Gilbert.
Gordon.
Hillyer.
Hinkley.
Howard.
Huggins.
Johnston, R. C.
Laessig.
Loane.
Lodge.
Orndorff.
Perkins, W. H.
Pleasants.
Price.
Scott.
Smith.
Williams, H. W.

Laboratory Work: (*Class in General Physics*). Dr. Hastings and Mr. Reid. (25).

Artz.
Baker.
Bayley.
Boston.
Campbell.
Carey.
Carroll.
Crum.
De Witt.
Fels.
Gilbert.
Gordon.
Hillyer.
Hinkley.
Howard.
Huggins.
Johnston, R. C.
Laessig.
Loane.
Orndorff.
Perkins, W. H.
Pleasants.
Price.
Scott.
Smith.

Chemistry. (45 Students).

Classes meet in the Chemical Laboratory.

Laboratory Work: Professor Remsen, Dr. Morse, Dr. Coale. Daily. (40).

Baker.
Bayley.
Boston.
Boyd.
Campbell.
Collins, A. T.
Cromwell.
Cumming.
Day, D. T.
Day, W. C.
Duggan.
Duncan.
Frick.
Friedenwald.
Gordon.
Guard.
Hillyer.
Huggins.
Johnston, R. C.
Keiser.
Kemp.
Laessig.
Liebig, R. A.
Lord, J. W.
Morrison.
Mussey.
Orndorff.
Page.
Palmer.
Pennington.
Perkins, C. A.
Piggot.
Pund.
Schubart.
Smith.
Stokes, H. N.
Stratton.
Wilkens.
Wilson.
Yonce.

General Chemistry: Professor Remsen. Daily, 9 A. M. (24).

Baker.
Boston.
Boyd.
Campbell.
Cromwell.
Cumming.
Duncan.
Gittings.
Gordon.
Guard.
Hillyer.
Huggins.
Johnston, R. C.
Keiser.
Laessig.
Morrison.
Mussey.
Page.
Perkins, C. A.
Schubart.
Smith.
Thomas, H. M.
Wiegand.
Wilkens.

Analytical Chemistry: Dr. Coale. Twice weekly, Monday and Tuesday, 9 A. M. (5).

Friedenwald.
Kemp.
Liebig, R. A.
Lord, J. W.
Orndorff.

Mineralogy: Dr. Morse. Three times weekly, Wednesday, Thursday, and Friday, 9 A. M. to 12 M. (13).

Applegarth.
Bayley.
Collins, A. T.
Day, D. T.
Day, W. C.
Duggan.
Keiser.
Liebig, R. A.
Orndorff.
Palmer.
Pund.
Robertson.
Wiegand.

Biology. (24 Students).

Classes meet in the Biological Laboratory.

Animal Physiology: Professor Martin. Four times weekly, Monday, Tuesday, Thursday, and Friday, 10 A. M. (16).

Beyer.
Cattell.
Donaldson, H. H.
Ely, J. S.
Jenkins.
Johnson, R. W.
Lee.
Mussey.
Nachtrieb.
Pennington.
Sieber.
Stevens.
Stokes, H. N.
Stratton.
Thomas, H. M.
Wilson.

General Biology: Dr. Sedgwick. Three times weekly, Monday, Wednesday, and Friday, 11 A. M. (10).

Beyer.
Duggan.
Ely, J. S.
Friedenwald.
Jenkins.
Kemp.
Lord, J. W.
Mussey.
Nachtrieb.
Wilson.

Osteology: Dr. Brooks. Twice weekly, Tuesday and Thursday, 11 A. M. (8).

Ely, J. S.
Friedenwald.
Jenkins.
Kemp.
Lord, J. W.
Mussey.
Nachtrieb.
Wilson.

Laboratory Work: Professor Martin and Dr. Sedgwick. Daily, 9 A. M. to 5 P. M. (24).

Beyer.
Cattell.
Conn.
Councilman.
Donaldson, H. H.
Duggan.
Ely, J. S.
Friedenwald.
Howell.
Jenkins.
Johnson, R. W.
Kemp.
Lee.
Lord, J. W.
Mussey.
Nachtrieb.
Osborn.
Pennington.
Sieber.
Stevens.
Stokes, H. N.
Stratton.
Thomas, H. M.
Wilson.

Greek. (88 Students).

Classes meet in 181 North Howard Street.

Seminary: Aristophanes: Professor Gildersleeve. Twice weekly, Monday and Wednesday, 12 M. (11).

Alexander.
Anderson, W. A.
Emerson.
Fleming.
Gillespie.
Miller, C. W. E.
Murray, J. S.
Short.
Sieber.
Williams, W. H.
Zweizig.

Metres: Professor Gildersleeve. Weekly, Thursday, 12 M. (10).

Alexander.
Anderson, W. A.
Emerson.
Fleming.
Gillespie.
Miller, C. W. E.
Murray, J. S.
Sieber.
Williams, W. H.
Zweizig.

Composition and Translation: Professor Gildersleeve. Twice weekly, Tuesday and Friday, 10 A. M. (10).

Alexander.
Cole.
Emerson.
Fleming.
Gillespie.
Miller, C. W. E.
Murray, J. S.
Sieber.
Williams, W. H.
Zweizig.

Comparative Grammar of Greek: Dr. Bloomfield. Weekly, Thursday, 4 P. M. (11).

Alexander.
Anderson, W. A.
Bright.
Emerson.
Fleming.
Jagemann.
Murray, J. S.
Short.
Spieker.
Tolman.
Williams, W. H.

Plato: *Phaedo:* Professor C. D. Morris. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 9 A. M. (10).

Cole.
Glenn, J.
Glenn, W. L.
Holstad.
Lodge.
McDaniel.
Stout.
Walz.
Williams, W. H.
Witzenbacher,

Xenophon: *Cyropaedia:* Dr. Spieker. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 11 A. M. (12).

Bevan.
Crutchfield.
Cumming.
Egge.
Gates.
Howard.
Loane.
McLane.
Merryman.
Rich.
Roberts.
Wilkens.

New Testament Greek: Mr. Harris. Twice weekly, Monday and Wednesday, 1 P. M. (11).

Beadenkopf.
Cole.
Cumming.
Gates.
Gillespie.
Lodge.
McDaniel.
Rich.
Sieber.
Walz.
Webb.

Prose Composition:

Class A. Professor C. D. Morris. Weekly, Monday, 9 A. M. (8).

Glenn, J.
Glenn, W. L.
Holstad.
Lodge.
McDaniel.
Stout.
Walz.
Witzenbacher.

Class B. Dr. Spieker. Weekly, Monday, 11 A. M. (12).

Bevan.
Crutchfield.
Cumming.
Egge.
Gates.
Howard.
Loane.
McLane.
Merryman.
Rich.
Roberts.
Wilkens.

Latin. (84 Students).

Classes meet in 181 North Howard Street.

Seminary: Cicero: *Orations and Letters:* Dr. Warren. Twice weekly, Tuesday and Friday, 11 A. M. (8).

Fleming.
Holstad.
Jones.
Miller, C. W. E.
Murray, J. S.
Pease.
Short.
Zweizig.

Cicero: *De Finibus:* Dr. Warren. Weekly, Wednesday, 11 A. M. (15).

Canfield.
Carey.
Crowe.
Feis.
Fleming.
Glenn, W. L.
Hinkley.
Holstad.
Jones.
Lodge.
Lord, J. D.
Pease.
Sieber.
Stout.
Walz.

Lucretius: Dr. Warren. Weekly, Wednesday, 11 A. M. (1

Canfield.
Carey.
Crowe.
Glenn, W. L.
Hinkley.
Jones.
Lodge.
Lord, J. D.
Pease.
Walz.

Tacitus: *Histories:* Professor C. D. Morris. Four times we
Tuesday, Wednesday, Thursday, and Friday, 10 A. M. (6).

Glenn, J.
Gregg.
Guard.
Rich.
Stout.
Wilkens.

Cicero: *Tusculan Disputations:* Dr. Spieker. Three times we
Tuesday, Thursday, and Friday, 12 M. (7).

Canfield.
Carey.
Glenn, W. L.
Hinkley.
Lodge.
Lord, J. D.
Walz.

Livy: Dr. Warren. Four times weekly, Tuesday, Wedne
Thursday, and Friday, 9 A. M. (10).

Bevan.
Crutchfield.
Egge.
Gates.
Loane.
Lyons.
McLane.
Pleasants.
Roberts.
Stokes, G.

Prose Composition:

Class A. Dr. Warren. Weekly, Monday, 11 A. M. (8).

Canfield.
Carey.
Glenn, W. L.
Hinkley.
Holstad.
Lodge.
Lord, J. D.
Walz.

Class B. Professor C. D. Morris. Weekly, Monday, 10 A. M.

Glenn, J.
Gregg.
Guard.
Rich.
Stout.
Wilkens.

Class C. Dr. Spieker. Weekly, Monday, 9 A. M. (10).

Bevan.
Crutchfield.
Egge.
Gates.
Loane.
Lyons.
McLane.
Pleasants.
Roberts.
Stokes, G.

Sanskrit. (8 Students). Dr. Bloomfield.

Rig-Veda: Twice weekly, Wednesday and Saturday, 10 A. M.

Bright.
Warren,

Comparative Grammar of Sanskrit: Weekly, Tuesd
A. M. (2).

Bright.
Warren,

Elementary Course: Twice weekly, Tuesday and Friday,
M. (6).

Alexander.
Anderson, W. A.
Murray, J. S.
O'Connor.
Spieker.
Williams,

German. (47 Students).

Classes meet in 111 West Monument Street.

(Advanced Course).

Gothic: Dr. Wood. Weekly, Wednesday, 11 A. M. (3)

Evenson.
Garthe.
Wright.

Old High German: Dr. Bright. Twice weekly, Tuesday
Friday, 4 P. M. (1).

Jagemann.

(Major Course).

German Literature: *Lectures in German:* Dr. Wood. A
nate Saturdays, 10 A. M. (5).

Dorsey.
Egge.
Evenson.
Glenn, J.
Ryttenber

Middle High German: Mr. Raddatz. Twice weekly,
day and Friday, 8 P. M. (4).

Bissing.
Garthe.
Sieber.
Witzenbac

Stilübungen and Essays: Mr. Raddatz. Second Thursd
each month, 4 P. M. (10).

Bissing.
Dorsey.
Egge.
Evenson.
Garthe.
Glenn, J.
Johnston, R. C.
Ryttenberg.
Sieber.
Witzenbac

Goethe: *Torquato Tasso: Iphigenie auf Tauris:* Dr. Bright. T
weekly, Monday and Thursday, 11 A. M. (11).

Dorsey.
Gillespie.
Glenn, J.
Johnston, R. C.
Murray, J. S.
Orndorff.
Pease.
Ryttenberg.
Stratton.
Tiffany.
Williams,

Lessing: *Nathan der Weise: Emilia Galotti:* DR. BRIGHT. Twice weekly, Tuesday and Friday, 11 A. M. (9).

Dorsey.
Evenson.
Glenn, J.
Johnston, R. C.
Orndorff.
Ryttenberg.
Stratton.
Tiffany.
Williams, H. W.

Prose Composition: MR. RADDATZ. Weekly, Wednesday, 4 P. M. (12).

Dorsey.
Egge.
Evenson.
Glenn, J.
Johnston, R. C.
Loane.
Orndorff.
Ryttenberg.
Stratton.
Tiffany.
Williams, H. W.
Witzenbacher.

(*Minor Course*).

LITERARY: *Schiller's Prosa, etc.:* DR. WOOD. Twice weekly, Tuesday and Friday, 12 M. (24).

Applegarth.
Artz.
Baker.
Boston.
Campbell.
Carroll.
Egge.
Gates.
Gilbert.
Guard.
Harlan.
Loane.
Lord, J. W.
Miller, E. G.
Morrison.
Perkins, W. H.
Rich.
Roberts.
Robertson.
Scaife.
Scott.
Stokes, G. C.
Tolman.
Wright.

HISTORICAL: *Dahn's Urgeschichte der germ. und rom. Völker.* DR. WOOD. Twice weekly, Monday and Thursday, 12 M. (12).

Applegarth.
Artz.
Caldwell.
Gates.
Gould,
Loane.
Perkins, W. H.
Roberts.
Robertson.
Stokes, G. C.
Tolman.
Yager.

SCIENTIFIC: *Hodges' Scientific German: Humboldt in Auswahl:* DR. BRIGHT. Twice weekly, Monday and Thursday, 12 M. (12).

Artz.
Baker.
Boston.
Campbell.
Carroll.
De Witt.
Gilbert.
Guard.
Lord, J. W.
Miller, E. G.
Morrison.
Scott.

PROSE COMPOSITION: DR. WOOD and MR. RADDATZ. Wednesday, 12 M. (24).

Applegarth.
Artz.
Baker.
Boston.
Caldwell.
Campbell.
Carroll.
Gates.
Gilbert.
Guard.
Harlan.
Loane.
Lord, J. W.
Miller, E. G.
Morrison.
Perkins, W. H.
Rich.
Roberts.
Robertson.
Scaife.
Scott.
Stokes, G. C.
Tolman.
Wright.

Romance Languages. (21 Students).

Classes meet in 111 West Monument Street.

Advanced Courses: (4 classes). *Provençal; Portuguese; Old French* [Seminary]; *Romance Dialects:* MR. ELLIOTT. Monday, Tuesday, and Thursday, 12 M.; Wednesday and Friday, 11 A. M. (4).

Garthe.
Jagemann.
O'Connor.
Taylor.

(*Major Course*).

Italian: MR. ELLIOTT. Twice weekly, Monday and Wednesday, 10 A. M. (4).

Gates.
Harlan.
Perkins, W. H.
Witzenbacher.

Old French: MR. MARCOU. Twice weekly, Tuesday and Thursday, 11 A. M. (8).

Harlan.
Perkins, W. H.
Witzenbacher.

French Literature: MR. MARCOU. Weekly, Friday, 11 A. M. (4).

Garthe.
Harlan.
Perkins, W. H.
Witzenbacher.

French: Minor Course:

HISTORICAL: *Fustel de Coulanges:* MR. MARCOU. Twice weekly, Tuesday and Thursday, 1 P. M. (8).

Canfield.
Cromwell.
Huggins.
Jones.
Kemp.
Lord, J. D.
Morrison.
Penniman.

SCIENTIFIC: *Elisée Reclus:* MR. MARCOU. Twice weekly, Tuesday and Friday, 12 M. (1).

Wiegand.

LITERARY: *Molière:* MR. MARCOU. Twice weekly, Wednesday and Friday, 1 P. M. (10).

Canfield.
Cromwell.
Huggins.
Jones.
Kemp.
Lord, J. D.
Morrison.
Penniman.
Perkins, W. H.
Witzenbacher.

GRAMMAR AND COMPOSITION: MR. MARCOU. Weekly, Monday, 1 P. M. (11).

Canfield.
Cromwell.
Huggins.
Jones.
Kemp.
Lord, J. D.
Morrison.
Penniman.
Perkins, W. H.
Wiegand.
Witzenbacher.

Conversation Class: M. RABILLON. Daily, 12 M. (8).

Faerber.
Garthe.
Harlan.
Jagemann.
Stout.
Thomas, W. J.
Tiffany.
Wiegand.

English. (43 Students).

Classes meet in 111 West Monument Street.

Anglo-Saxon Grammar: *Lectures:* DR. WOOD. Weekly, Wednesday, 4 P. M. (6).

Crum.
Evenson.
Garthe.
Jagemann.
Tolman.
Wright.

Anglo-Saxon: *Sweet's Reader, etc.:* DR. WOOD. Twice weekly, Tuesday and Friday, 4 P. M. (6).

Crum.
Evenson.
Garthe.
Robertson.
Tolman.
Wright.

Anglo-Saxon: *Elementary Course:* DR. WOOD. Weekly, Thursday, 4 P. M. (11).

Cole.
Egge.
Ely, J. S.
Fels.
Gould.
Miller, E. G.
Ramage.
Steiner.
Stratton.
Wiegand.
Wilhelm.

Early English: *Morris's Specimens, Pt. I, etc.:* DR. WOOD. Twice weekly, Monday and Thursday, 11 A. M. (6).

Crum.
Evenson.
Garthe.
Jagemann.
Robertson.
Tolman.

Shakspeare: *Macbeth:* DR. WOOD. Weekly, Tuesday, 8 P. M. (9).

Egge.
Fels.
Miller, E. G.
Patten.
Robertson.
Sewall.
Steiner.
Stratton.
Wiegand.

English Phonetics: *Sweet's Handbook:* DR. WOOD. Weekly, Monday, 4 P. M. (8).

Egge.
Evenson.
Garthe.
Miller, E. G.
Steiner.
Stratton.
Tolman.
Wiegand.

Modern English: DR. BROWNE. Twice weekly, Wednesday and Friday, 2 P. M. (30).

Anderson, T.
Artz.
Bayley.
Bemis.
Bevan.
Bissing.
Cromwell.
Crutchfield.
Cumming.
Egge.
Gates.
Glenn, W. L.
Howard.
Kemp.
Loane.
McCay.
McLane.
Miller, E. G.
Patten.
Pleasants.
Rich.
Ryttenberg.
Sewall.
Shinn.
Sieber.
Steiner.
Stratton.
Thomas, H. M.
Wiegand.
Wilkens.

History and Political Economy. (59 Students).

Classes meet in 113 West Monument Street, except where otherwise specified.

Seminary: Institutional History: DR. ADAMS. Weekly, Friday, 8 P. M. (21).

Bemis.
Brinton.
Caldwell.
Dewey.
Goodman.
Gould.
Ingle.
Jameson.
Johnson, J.
Linthicum.
MacClintock.
Ramage.
Rose.
Scaife.
Shinn.
Sollers.
Tiffany.
Wilhelm.
Williams, F. R.
Wood, A.
Yager.

Sources of English History: DR. ADAMS. Weekly, Saturday, 12 M., Peabody Institute. (14).

Bemis.
Caldwell.
Dewey.
Gould.
Ingle.
MacClintock.
Ramage.
Scaife.
Shinn.
Thomas, W. J.
Wilhelm.
Williams, F. R.
Wood, A.
Yager.

Modern History: DR. ADAMS. Daily, 2 P. M. (19).

Applegarth.
Caldwell.
Canfield.
Carey.
Dorsey.
Gregg.
Hinkley.
Liebig, R. A.
Lord, J. D.
Lyons.
MacClintock.
McDaniel.
Miller, E. G.
Penniman.
Scaife.
Shinn.
Stokes, G. C.
Walz.
Williams, H. W.

Introductory Historical Course: DR. ADAMS. Weekly, Wednesday, 5 P. M., in Hopkins Hall. (37).

Anderson, T.
Applegarth.
Artz.
Bayley.
Bevan.
Caldwell.
Canfield.
Carey.
Cumming.
Dorsey.
Gates.
Glenn, W. L.
Gregg.
Hinkley.
Howard.
Kemp.
Liebig, R. A.
Loane.
Lord, J. D.
Lyons.
MacClintock.
McCay.
McDaniel.
McLane.
Miller, E. G.
Patten.
Penniman.
Pleasants.
Ryttenberg.
Scaife.
Sewall.
Shinn.
Steiner.
Stokes, G. C.
Walz.
Wilkens.
Williams, H. W.

Classical History: DR. JAMESON. Twice weekly, Tuesday and Thursday, 2 P. M. (18).

Anderson, T.
Artz.
Bayley.
Bevan.
Cumming.
Gates.
Glenn, W. L.
Howard.
Kemp.
Loane.
McCay.
McLane.
Patten.
Pleasants.
Ryttenberg.
Sewall.
Steiner.
Wilkens.

Finance: DR. ELY. Three times weekly, Monday, Wednesday, and Friday, 4 P. M. (17).

Bemis.
Caldwell.
Fels.
Goodman.
Gould.
Harlan
Ingle.
MacClintock.
Ramage,
Scaife.
Shinn.
Thomas, W. J.
Tiffany.
Wilhelm.
Williams, F. R.
Wood, A.
Yager,

Principles of Political Economy: Minor Course: DR. ELY. Daily, 12 M, (9).

Cromwell.
Fels.
McCay.
MacClintock.
Patten.
Scaife.
Sewall.
Shinn.
Tiffany.

History of Philosophy, Ethics, Etc. (89 Students).

Classes meet in 187 Howard Street, except where otherwise specified.

Seminary: Science of Knowledge: PROFESSOR G. S. MORRIS. Twice weekly, Monday and Thursday, 11 A. M. (9).

Anderson, W. A.
Cattell.
Cole.
Dewey.
Gordon.
Jastrow.
McDaniel.
Sieber.
Thomas, W. J.

History of Philosophy in Great Britain: PROFESSOR G. S. MORRIS. Three times weekly, Tuesday, Wednesday, and Friday, 11 A. M. (10).

Anderson, W. A.
Cattell.
Cole.
Dewey.
Gordon.
Jastrow.
McDaniel.
Sieber.
Tolman.
Wright.

Philosophy of History (Hegel): PROFESSOR G. S. MORRIS. Weekly, Tuesday, 12 M. (11).

Anderson, W. A.
Bemis.
Caldwell.
Cattell.
Cole.
Dewey.
Jastrow.
Sieber.
Thomas, W. J.
Wilhelm.
Yager.

Ethics and History of Philosophy: (*Minor Course*)*:* PROFESSOR G. S. MORRIS. Daily, Monday, 5 P. M., Tuesday, 1 P. M., Wednesday, Thursday, and Friday, 12 M. (5).

Friedenwald.
Lyons.
Merryman.
Ryttenberg.
Steiner.

Ethics: Lectures: PROFESSOR G. S. MORRIS. Weekly, Monday, 5 P. M, Hopkins Hall. (27).

Anderson, T.
Artz.
Bayley.
Bevan.
Cole.
Crutchfield.
Egge.
Ely, J. S.
Evenson.
Faerber.
Fels.
Friedenwald.
Glenn, W. L.
Guard.
Jastrow.
Kemp.
Loane.
Lyons.
McCay.
McLane.
Merryman.
Pleasants.
Ryttenberg.
Steiner.
Thomas, H. M.
Wilkens.
Wright.

Logic. (14 Students).

MR. PEIRCE. Four times weekly, Tuesday and Thursday, 5 P. M., Wednesday and Friday, 9 A. M., 187 Howard Street.

Fels.
Glenn.
Howard.
Jastrow.
Merryman.
Penniman.
Perkins, W. H.
Taber.
Thomas, W. J.
Tiffany.
Veblen.
Williams, H. W.
Williams, W. H.
Witzenbacher.

Elocution. (29 Students).

MR. WOODWORTH. Daily, 10 A. M. to 1 P. M., Hopkins Hall.

Campbell.
Canfield.
Cole.
Crutchfield.
Cumming.
Davis.
Dorsey.
Fels.
Harlan.
Hinkley,
Kemp.
Loane.
McCay.
McDaniel.
Merryman.
Miller, E. G.
Penniman.
Rich.
Roberts.
Robinson.
Ryttenberg.
Sewall.
Sieber.
Steiner.
Stokes, G. C.
Stratton.
Tolman.
Walz.
Williams, F. R.

Drawing.

MR. NEWELL. Twice weekly, Monday and Friday, 2.15 P. M.

(This course began November 17).

LIBRARY OF THE PEABODY INSTITUTE.

RECENT ACCESSIONS.

The library of the Peabody Institute has recently added some very important books to its collections. Among others may be noticed an entire set of the publications of the Goettingen Academy of Sciences, including the Abhandlungen, in quarto.

Some of the departments of the library thus enlarged are these: —

Sources of Spanish history are represented by the *Coleccion de documentos ineditos para la historia de España*, in 77 vols.

Italian and Roman Archæology, by the *Monumenti, Annali, and Bolletino of the Istituto di Corrispondenza Archeologica, Roma.* The *Monumenti* by itself forming a large collection of fine, large engravings of specially interesting, newly discovered relics from the ruins of Rome, Pompeii, etc.

Botany has been enriched by a full set of the *Bulletin de la Société Botanique de France.*

French history is opened anew in the very extensive series known by the general title of *Documents inédits sur l'histoire de France.* The period of the French Revolution is set forth in several hundred volumes, many of them printed at or near the time when the events were happening. One of these, the *Tableaux historiques de la Révolution française*, forms three large folio volumes, and gives good copper-plate engravings of many scenes illustrating the reign of terror.

The group of Fine Arts has been improved by the addition of Comte de Clarac's *Musée de Sculpture*, illustrated by six folios of engravings; also by Blanc's *Histoire des peintres de toutes les écoles;* by Garrucci's *Storia della arte Cristiana*, and by Racinet's *Costume historique.*

The Challenger expedition publications, and the Survey of Western se have also been added.

ore, *November* 11, 1882. P. R. UHLER, *Librarian.*

BALTIMORE NATURALISTS' FIELD CLUB.

Arrangements have been made for a series of lectures on selected topics in Natural Science to be given before the Field Club during the current session of the University.

The opening address by PROFESSOR H. NEWELL MARTIN upon the *Life and Work of Charles Darwin*, was given in Hopkins Hall, Monday, November 27.

WEATHER RECORDS OF BALTIMORE.

Any one who has kept a meteorological record (especially barometer, temperatures, and wind direction) for a series of years in the city of Baltimore, will confer a favor by communicating with the President of the Johns Hopkins University.

LECTURES TO MEDICAL MEN.

DR. WILLIAM T. COUNCILMAN, Fellow by Courtesy of the Johns Hopkins University and late Assistant in Biology, will deliver during this winter a course of ten lectures on pathological topics. Microscopic and other specimens will be exhibited illustrating the lectures, which will be largely demonstrative in character.

Six lectures will be devoted to the lower organisms and their connection with the production and spread of infectious diseases; one will be upon tubercle and tuberculosis; and the remainder upon tumors.

THE COMING TRANSIT OF VENUS.

In response to a general desire for information in respect to the arrangements which have been made in this and other countries for observing the *Transit of Venus*, which will occur December 6th, 1882, MR. C. S. HASTINGS, Ph. D, will deliver a lecture upon this subject in Hopkins Hall, Friday, December 1st, at 8 p. m.

President Gilman will give a brief historical statement of previous observations. At the close of the lecture, there will be a social gathering in the Library.

Cards of admission will be requisite,—and as the space at command is so limited, they will be given to those who are interested in scientific observations of this character. It is proposed to have several similar gatherings during the session, when subjects of general interest in other departments will be presented,—and other groups of students will be invited.

The article on the system of Collegiate Instruction in the Johns Hopkins University prepared for these *Circulars* has been published in the Seventh Annual Report and will not appear here.

UNIVERSITY DIRECTORY.

The following list gives the names and residences of the Officers, Students, etc., as entered at the Registrar's office.

Adams, H. B.	*Associate.*	41 Cathedral St.
Adkins, W. H.	*History (Sem.)*	117 N. Charles St.
Alexander, W. J.	*Fellow.*	71 McCulloh St.
Anderson, T.	*Special.*	174 St. Paul St.
Anderson, W. A.	*Graduate.*	286 Madison Av.
Angell, T.	*Graduate.*	Washington, D. C.
Applegarth, A. C.	*Matriculate.*	632 W. Fayette St.
Artz, C. W.	*Matriculate.*	75 Edmondson Av.
Baker, W. S. G., Jr.	*Special.*	Govanstown.
Barnes, E.	*Graduate.*	28 McCulloh St.
Bayley, W. S.	*Matriculate.*	641 W. Lombard St.
Beadenkopf, T. M.	*Graduate.*	14 S. Chester St.
Bemis, E. W.	*Graduate.*	40 McCulloh St.
Bevan, W. L.	*Special.*	101 W. Lanvale St.
Beyer, H. G.	*Graduate.*	76 Saratoga St.
Bissing, G.	*Graduate.*	264 W. Lombard St.
Bland, J. C.	*Graduate.*	Philadelphia.
Bloomfield, M.	*Associate.*	123 W. Madison St.
Boston, J. G.	*Special.*	464 Madison Av.
Bowdoin, H. J.	*History (Sem.)*	130 N. Charles St.
Boyd, W. S.	*Graduate.*	54 McCulloh St.
Brace, D. B.	*Graduate.*	212 Druid Hill Av.
Bright, J. W.	*Assistant.*	33 Garden St.
Brinton, D. L.	*History (Sem.)*	45 Forrest Place.
Brooks, W. K.	*Associate.*	181 N. Calvert St.
Brown, G. W.	*Trustee.*	89 W. Chase St.
Browne, W. H.	*Librarian.*	2 Huntingdon Av.
Caldwell, H. W.	*Graduate.*	181 Linden Av.
Campbell, J. P.	*Matriculate.*	352 N. Eutaw St.
Canfield, W. B.	*Matriculate.*	43 Cathedral St.
Carey, G. G., Jr.	*Matriculate.*	265 N. Eutaw St.
Carpenter, W. H.	*Fellow by Courtesy.*	"The Brexton."
Carroll, J. H.	*Matriculate.*	42 Franklin St.
Cattell, J. M.	*Fellow.*	209 W. Biddle St.
Coale, R. D.	*Assistant.*	215 Madison Av.
Cole, T. L.	*Special.*	65 McCulloh St.
Collins, A. T.	*Special.*	Mt. Washington.
Collins, J. V.	*Graduate.*	28 McCulloh St.
Conn, H. W.	*Graduate.*	181 N. Calvert St.
Converse, J. H.	*Special.*	Bar Library.
Councilman, W. T.	*Fellow by Courtesy.*	126 W. Biddle St.
Craig, T.	*Associate.*	139 St. Paul St.
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Day, W. C.	*Fellow.*	207 Madison Av.
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Ely, R. T.	*Associate.*	288 Madison Av.
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Murray, N.	*Registrar's Office.*	148 St. Paul St.
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Thomas, J. C.	*Trustee.*	107 Madison Av.
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Williams, W. H.	*Graduate.*	175 W. Biddle St.
Wilson, E. V.	*Matriculate.*	174 Linden Av.
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Winslow, F.	*Graduate.*	*Marine Laboratory.*
[illegible], W. J.	*Matriculate.*	34 McCulloh St.
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Wood, H.	*Associate.*	67 Oak St.
[illegible], C. L.	*Instructor.*	181 Linden Av.
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Yager, A.	*Graduate.*	24 McCulloh St.
[illegible], G. T.	*Graduate.*	Lutherville.
[illegible], J. H.	*Graduate.*	102 Franklin St.

(A.) Not now in attendance on the University.

UNIVERSITY ROOMS AND HOURS.

Unless otherwise indicated the rooms designated are in the University Buildings, corner of Howard and Ross Streets.

Consultation Hours.

In order to promote economy of time on the part of students as well as officers, brief consultations may be had with the gentlemen here named at the hours and places indicated. In case prolonged conference is desirable special appointments may be made by notes exchanged at the Registrar's office or otherwise. The person named will usually be accessible for some minutes after the appointed hour. The appointments do not include Saturday.

Gilman, D. C.	*President's Office.*		1 p. m.
Adams, H. B.	*Registrar's Office.*		9 a. m.
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Bright, J. W.	*111 W. Monument St.*	Except Wed.	12 m.
Brooks, W. K.	*Biological Laboratory.*		11 a. m.
Browne, W. H.	*Library.*		9 a. m. to 5 p. m.
Coale, R. D.	*Chemical Laboratory.*		10 a. m.
Craig, T.	*Room 2.*		4 p. m.
Ely, R. T.	*113 W. Monument St.*		1 p. m.
Elliott, A. M.	*111 W. Monument St.*		1 p. m.
Franklin, F.	*Room 12.*		12 m.
Gildersleeve, B. L.	*[illegible] Howard St.*		11 a. m.
Hastings, C. S.	*Room 5.*		11 a. m.
Jameson, J. F.	*113 W. Monument St.*	(Tues. and Thurs.)	3 p. m.
Martin, H. N.	*Biological Laboratory.*		12 m.
[illegible]	*111 W. Monument St.*		1 p. m.
Morris, C. D.	*[illegible] Howard St.*		11 a. m.
Morris, G. S.	*1?? Howard St.*		1 p. m.
Morse, H. N.	*Chemical Laboratory.*		2 p. m.
Newell, M.	*Hopkins Hall.*	(Mon. and Friday)	2.15 p. m.
Peirce, C. S.	*1?? Howard St.*	(Tues. and Thurs.)	4.30 p. m.
[illegible]	*1?? Howard St.*		12 m.
[illegible]	*Chemical Laboratory.*		11 a. m.
[illegible]	*Physical Laboratory.*		9 a. m.
[illegible]	*Biological Laboratory.*		12 m.
Spieker, E. H.	*1?? Howard St.*		11.45 a. m.
Story, W. E.	*Room 15.*		12 m.
Sylvester, J. J.	*Room 17.*		2 p. m.
Warren, M.	*1?? Howard St.*		12 m.
Wood, H.	*111 W. Monument St.*		1 p. m.
[illegible], C. L.	*Hopkins Hall.*		10 a. m. to 1 p. m.

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These offices are open daily, except Saturdays, from 9 a. m. to 5 p. m., and on Saturdays, from 9 a. m. to 3 p. m., and from 4 to 4.30 p. m.

Mr. Meyer's address is 60 Bolton St.—Mr. Ball's is [illegible] N. Arlington Av.

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(Including Saturdays.)

Mails are received from the Post-office at 9 a. m. and 4 p. m.

Mails are sent to the Post-office at 8 a. m. and 3 p. m.

Mails are sent to the Street Letter-Box at 11.40 a. m. and 5.45 p. m.

☞ Memoranda, notes, letters, and parcels may be left at the Registrar's office to be distributed at 9 a. m. and 4 p. m.

Library and Laboratories.

The Library is open daily, including Saturday, from 9 a. m. to 10 p. m.

The Biological, Chemical, and Physical Laboratories are open daily, except Saturday, from 9 a. m. to 5 p. m.

JOHNS HOPKINS
UNIVERSITY CIRCULARS

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CALENDAR, 1882–83.

Tuesday, September 19.	**Current Academic Year Began.**
Friday, December 22—Tuesday, Jan. 2.	**Christmas Recess.**
Tuesday, January 2.	**Mr. F. Seymour Haden's Lectures on Etching Begin. (See p. 36).**
Wednesday, January 3.	**Meeting of Scientific Association, 8 P. M.**
Friday, January 5.	**Meeting of Philological Association, 12 M.**
Monday, January 8.	**Professor G. S. Morris's Course on Philosophy and Christianity Begins. (See p. 36).**
Tuesday, January 9.	**Meeting of Metaphysical Club, 8 P. M.**
Wednesday, January 10.	**Professor Corson's Course on Poetry Begins. (See p. 36).**
Saturday, January 13.	**M. Rabillon's Course in French Literature Begins. (See p. 36).**
Wednesday, January 17.	**Meeting of Historical and Political Science Association, 8 P. M.**
Friday, January 19.	**Meeting of Mathematical Society, 8 P. M.**
Friday, June 8.	**Term of Instruction Closes.**

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SCIENTIFIC NOTES

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MATHEMATICS.

On the Fundamental Theorem in the New Method of Partitions, by J. J. Sylvester.

[Abstract of a paper read before the University Mathematical Society, November 15, 1882].

The new method of partitions which I gave to the world more than a quarter of a century ago is an application of a theorem which, I think it must be conceded, is, after Newton's Binomial Theorem, the most important organic theorem which exists in the whole range of the Old Algebra. What Newton's theorem effects for the development of *radical*—that theorem accomplishes for the development of *fractional* forms of algebraical functions.

One (but not the most perfect) form in which it can be presented is the following. If Fx be any proper algebraical fraction in x, whose infinity roots (*i. e.*, the values of x which make Fx infinite) are $a, b, \ldots l$, quantities all supposed to differ from zero then the coefficient of x^n for any value of n will be the residue, *i. e.*, the coefficient of $\frac{1}{x}$ in

$$\Sigma(\lambda^n e^{-nx}) F(\lambda e^{-x}) \; [\lambda = a, b, \ldots, l].$$

By supposing Fx broken up into proper simple fractions of the form $\Sigma \frac{fx}{(a-x)^i}$ it is very easy to see that the theorem will be true in general if true for $\frac{fx}{(a-x)^i}$ and from this it is but a step to see that the theorem will be true in general if true for the simplest form of rational function, *i. e*, $\frac{1}{(1-x)^i}$.

All then that remains to do is to show that the coefficient of x^n in this fraction is the same as the coefficient of $\frac{1}{x}$ in $\frac{e^{nx}}{(1-e^{-x})}$ which may be done as follows:

$$\frac{1}{(1-e^{-x})^i} = \left(1-\frac{\delta_x}{1}\right)\left(1-\frac{\delta_x}{2}\right)\left(1-\frac{\delta_x}{3}\right)\ldots\left(1-\frac{\delta_x}{(i-1)}\right)\left(\frac{1}{1-e^{-x}}\right)$$

$$= \left(1 - A\delta_x + B\delta_x^2 - C\delta_x^3 \ldots\right)\left(\frac{1}{x} + \ldots\right)$$

$$= \left(\frac{1}{x} + \frac{A}{x^2} + \frac{1\,2B}{x^3} + \frac{1.2.3C}{x^4} + \ldots\right) + \text{positive powers of } x.$$

Therefore the coefficient of $\frac{1}{x}$ in $\frac{1 + nx + \frac{n^2}{1.2}x^2 + \frac{n^3}{1.2.3}x^3 + \ldots}{(1-e^{-b})^i}$.

$$= (1 + An + Bn^2 + Cn^3 + \ldots)$$

$$= \left(1+\frac{n}{1}\right)\left(1+\frac{n}{2}\right)\left(1+\frac{n}{3}\right)\ldots\left(1+\frac{n}{i-1}\right)$$

$$= \frac{(n+1)(n+2)\ldots(n+i-1)}{1, 2, \ldots i} = \text{coefficient of } x^n \text{ in } \frac{1}{(1-x)^i}. \quad \text{Q.E D.}$$

This method of proof, however, is not the simplest or best; as soon as we mould the theorem into a form most easily admitting of being expressed in general terms that very form itself suggests a simpler (nay, so to say, an instantaneous) proof, and moreover relaxes an unnecessarily stringent condition in the previous statement of the theorem.

Of course by a finite infinity root of a function no one can fail to understand a value of the variable differing from zero which makes the function infinite. This then is the true statement of the theorem in general terms.

In any proper-fractional function developed in ascending powers of a variable, the constant term is equal to the Residue (with its sign changed) of a sum of functions obtained by substituting in the given function in place of the variable the product of each, in succession, of its finite infinity roots into the exponential of the variable.

That is to say, if the proper-fraction $Fx = \frac{\phi x}{x^i(x-a)^j(x-b)^k \ldots (x-l)^w}$ stant term (with its sign changed) in this fraction developed in ascending powers of x is the same as the Residue of $\Sigma F(\lambda e^x)[\lambda = a, b, \ldots l]$.

To prove this it is only necessary to suppose the fraction Fx separated into simple partial fractions with constant numerators and the theorem becomes self-evident.*

It follows, therefore, writing n in place of i that the coefficient of x^n in ascending-power series for the fraction $Gx = \left(\frac{\phi x}{(x-a)^j \ldots (x-l)^w}\right)$ will be the Residue with its sign changed of $\Sigma(a^{-n}e^{-nx})G(ae^x)$, or which is the same thing is the Residue of $\Sigma a^{-n}e^{nx}G(ae^{-x})$ which theorem we now see is true not merely for the case where G is a proper-fraction, *i. e.*, is a function of x whose degree is a negative integer but remains true when the degree of G is any number inferior to n, for when that condition is satisfied $\frac{G}{x^n}$ is a proper fraction, which is all that is required in order for the parent theorem to apply.

The Maximum Value of a Certain Determinant, by E. W. Davis.

[Abstract of a paper read before the University Mathematical Society, November 15, 1882].

The elements of a determinant being restricted to a variation between the limits $-a$ and $+a$, it is found that for all determinants whose order is greater than 2, a numerical maximum will be obtained by putting the elements $(-a)$ in the principal diagonal and making all the other elements of the determinant $+a$. If we denote such a determinant of order n when $a = 1$ by D_n, and the minor of an element in the ith row and kth column by A_{ik}, we have always $A_{ii} = D_{n-1}$, $A_{ik} = \frac{-D_{n-1}}{n-3}$, so that

$$D_n = -\left(1+\frac{n-1}{n-3}\right).\,D_{n-1} = +\left(1+\frac{n-1}{n-3}\right)\left(1+\frac{n-2}{n-4}\right).\,D_{n-2}$$

$$= \pm\left(1+\frac{n-1}{n-3}\right)\left(1+\frac{n-2}{n-4}\right)\ldots\ldots\left(1+\frac{5}{3}\right)\left(1+\frac{4}{2}\right)\left(1+\frac{3}{1}\right).\,D_3$$

$$= \pm(n-2)2^{n-1}, \text{ since } D_3 = 4.$$

The sign will be ± according as n is $\frac{\text{odd}}{\text{even}}$.

The effect of a change in any element is to lessen the greatest factor leaving the rest the same.

For the maximum cubic determinant $D_n^{(3)}a^n$, we have merely to make all the strata identical and equal to $D_n^{(2)}$. Its value is $\pm n!\,D_n^{(2)}a^n$.

The 4-dimensional determinant may be looked upon as a sort of determinant of plane determinants, the terms of the development being cubic determinants of which the plane determinants are the strata. In this quasi-determinant the same rule of signs applies as in the ordinary determinant and we get for the maximum value accordingly $\pm D_n^{(2)}.n!\,D_n^{(2)}a^n = \pm n!(D_n^{(2)})^2$.

Similarly,

$$D_n^{(2p)} = \pm(n!)^{p-1}(D_n^{(2)})^p,$$
$$D_n^{(2p+1)} = \pm(n!\,D_n^{(2)})^p.$$

In any of these determinants we have at once a formula for the maximum number of positive terms in the development. This is for $D_n^{(q)}$:

$$\frac{(n!)^{q-1} \pm D_n^{(q)}}{2}.$$

We use the ± sign according as $D_n^{(q)}$ is ±.

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* It must, however, previously be shown that the residue of $\frac{1}{(1-e^x)^i}$, where i is a positive integer, the same as that of $\frac{1}{1-e^x}$, *i. e.*, is -1; this becomes obvious from the consideration that the change of i into $i+1$ alters the quantity to be residuated by $\frac{e^x}{(1-e^x)^{i+1}}$, *i. e.*, by the differential derivative of $\frac{1}{(1-e^x)^i}$ divided by i, of which the residue is necessarily zero—that being true for the differential derivative of any series of powers of a carrier variable.

Notes on Symmetric Functions, by W. P. DURFEE.

[Abstract of a paper read before the University Mathematical Society, November 15, 1882].

(1). *On Tabulation.*

Faà de Bruno has published in his "Formes Binaires" tables which give the values of the symmetric functions of the roots of an equation in terms of its coefficients. These tables are symmetrical and the units, which are coefficients of the function of the *opposite* or *conjugate* partition, lie in the sinister diagonal, with the exception of those belonging to the self opposite partitions. My object is to show how such an arrangement may be effected for any weight. Let the partitions of 8, for example, be written as follows:—

$$\binom{8}{1^8}\binom{71}{21^6}\binom{6\ 2}{2^21^4}\binom{5\ 3}{2^31^2}\binom{4^2}{2^4}\binom{61^2}{31^5}\binom{521}{321^3}\binom{43\ 1}{32^21}\binom{4\ 2^2}{3^21^2}\binom{3^22}{3^22}\binom{51^3}{41^4}$$

$$\binom{421^2}{421^2}\binom{3^21^2}{4.2^2}\binom{32^21}{43\ 1}\binom{2^4}{4^2}\binom{41^4}{51^3}\binom{321^3}{521}\binom{2^31^2}{5\ 3}\binom{31^5}{61^2}\binom{2^21^4}{6\ 2}\binom{21^6}{71}\binom{1^8}{8}$$

The partitions in the upper line are separated into groups containing 1, 2, 3, &c., parts, and in these groups are arranged in dictionary order. The partitions of the lower line are the opposites of those to which they are joined.

Now it is easily shown that a symmetric function represented by a partition in the upper line can contain no function of the coefficients represented by a partition which precedes its opposite in the lower line, and also that a symmetric function represented by a partition in the lower line can contain no function of the coefficients represented by a partition following its opposite in the upper line. It is an easy consequence from what precedes that the desired arrangement will be effected by writing the partitions representing both symmetric functions and combinations of coefficients, in the following order, viz: the first half of the partitions, not counting the self-opposite ones, in the above order; the self opposite partitions without regard to order; the opposites of the first half in inverse order.

It might be well to add that Faà de Bruno has given in Vol. 76 *Comptes Rendus*, a table of the values of the symmetric functions of weight 8, which is symmetrically arranged in a half square. This table contains several errors. The most noticeable are that the coefficient of $a_3^2a_2$ in the value of $\Sigma\alpha^3\beta^3\gamma^2$ and the coefficient of $a_4a_2a_1^2$ in the value of $\Sigma\alpha^4\beta^2\gamma\delta$ are given as zero, while each should evidently be unity. For the weight 8 it is impossible to arrange the table symmetrically and at the same time confine it to a half square, and it is probable that the same thing is true for higher orders.

(2). *Extension of Waring's Formula.*

Waring has given the following formula:

$$\Sigma\alpha^n=\sigma_n=$$
$$n\Sigma(-)^{n+\lambda_1+\lambda_2+\dots+\lambda_k-1}\frac{\pi(\lambda_1+\lambda_2+\dots+\lambda_k-1)}{\pi\lambda_1,\pi\lambda_2,\dots\pi\lambda_k}s_1^{\lambda_1},s_2^{\lambda_2}\dots s_k^{\lambda_k},$$

where $\lambda_1+2\lambda_2+3\lambda_3+\dots k\lambda_k=n$.

In this σ_n denotes the sum of the nth powers of the elements, $s_1, s_2,\dots s_k$, the simple symmetric functions and π the factorial.

Combining this with the well-known formula

$$E\left(\frac{r+s}{r}\right)\Sigma\alpha^r\beta^s=\sigma_r\sigma_s-\sigma_{r+s},\ (r\geqq s),$$

we obtain

$$E\left(\frac{r+s}{r}\right)\Sigma\alpha^r\beta^s=\Sigma(-)^{\Lambda+r+s-1}\times$$
$$\frac{(r+s)\pi(\Lambda-1)-rs\Sigma\dfrac{\pi(N-1)}{\pi(\nu_1)\pi(\nu_2)\dots\pi(\nu_n)}\lambda_1^{(\nu_1)}\lambda_2^{(\nu_2)}\dots\lambda_n^{(\nu_n)}}{\pi(\lambda_1)\pi(\lambda_2)\dots\pi(\lambda_k)}s_1^{\lambda_1}s_2^{\lambda_2}\dots s_k^{\lambda_k},$$

where
$$\Lambda=\lambda_1+\lambda_2+\dots+\lambda_k,$$
$$N=\nu_1+\nu_2+\dots+\nu_n,$$
$$\lambda_1+2\lambda_2+3\lambda_3+\dots+k\lambda_k=r+s,$$
$$\nu_1+2\nu_2+3\nu_3+\dots+n\nu_n=r,$$

and $\lambda_1^{(\nu_1)}$ signifies $\lambda_1(\lambda_1-1)\dots(\lambda_1-\nu_1+1)$.

On the Number of Self-Opposite Partitions, by W. P. DURFEE.

[Abstract of a paper read at the University Mathematical Society, October 18, 1882).

A self-opposite or self-conjugate partition may be defined as a partition such that if set out as an array of units, the sums of the columns reproduce the original partition.

5321^2 for example is a self-opposite partition of 12.

$$\begin{array}{ccccc|c}
1&1&1&1&1&5\\
1&1&1&&&3\\
1&1&&&&2\\
1&&&&&1\\
1&&&&&1\\
\hline
5&3&2&1&1&
\end{array}$$

It is evident that every such array may be looked upon as arranged symmetrically about a square of units (set off in the above illustration by dotted lines) which square must contain an odd or even number of units according as n, the partitioned number, is odd or even, since the number of units outside the square is necessarily even.

If we denote the number of units in the square by q^2, those outside will be $n-q^2$ of which $\frac{1}{2}(n-q^2)$ will be to the right and $\frac{1}{2}(n-q^2)$ below the square. Now the partition will remain self-opposite whatever the arrangement of the $\frac{1}{2}(n-q^2)$ units to the right provided the $\frac{1}{2}(n-q^2)$ units below be arranged symmetrically, but the number of ways of arranging these $\frac{1}{2}(n-q^2)$ units is precisely the number of ways of dividing $\frac{1}{2}(n-q^2)$ into q or fewer parts which I shall represent by $[\frac{1}{2}(n-q^2):q]$. In the example given above $\frac{1}{2}(n-q^2)=4$, so that in addition to the one set out which corresponds to the partition 3 1 12 may have two other self-opposite partitions corresponding to 4 0; 2 2:

$$\begin{array}{cccccc|c}
1&1&1&1&1&1&6\\
1&1&&&&&2\\
1&&&&&&1\\
1&&&&&&1\\
1&&&&&&1\\
1&&&&&&1\\
\hline
6&2&1&1&1&1&
\end{array}
\qquad
\begin{array}{cccc|c}
1&1&1&1&4\\
1&1&1&1&4\\
1&1&&&2\\
1&1&&&2\\
\hline
4&4&2&2&
\end{array}$$

It can have no other since there is no other even square less than 12 to serve as base.

If for the general case we denote the number of self-opposite partitions of n by Pn we shall have $Pn=\Sigma[\frac{1}{2}(n-q^2):q]$ where the summation sign is to extend to all $\frac{\text{odd}}{\text{even}}$ integer values of q less than $\sqrt{n}$ according as n is $\frac{\text{odd}}{\text{even}}$.

Note on the above, by J. J. SYLVESTER.

Mr. Durfee's very elegant and interesting theorem above given may, by help of Euler's law of reciprocity, be expressed in the following terms.

Let fx and ϕx represent respectively:

$$\frac{1}{1-x}+\frac{x^2}{(1-x)(1-x^2)(1-x^3)}$$
$$+\frac{x^{12}}{(1-x)(1-x^2)(1-x^3)(1-x^4)(1-x^5)}+\dots$$
$$+\frac{x^{2i^2+2i}}{(1-x)\dots(1-x^{2i+1})}+\dots;$$

and
$$\frac{x^2}{(1-x)(1-x^2)}+\frac{x^8}{(1-x)(1-x^2)(1-x^3)(1-x^4)}+\dots$$
$$+\frac{x^{2i^2}}{(1-x)\dots(1-x^{2i})}+\dots,$$

then the number of self-conjugate partitions of $2m+1$ and of $2m$ are the coefficients of x^m in the ascending expansions of fx, ϕx, respectively.

Thus, suppose $2m+1=13$, the coefficient of x^6 in fx developed, *i. e.*, $\frac{6}{1,}+\frac{2}{1,2,}$ or 3 is the number of self-conjugate partitions of 13.

These will be found to be 7 1 1 1 1 1 1, 4 4 3 2, 5 3 3 1 1. To find the conjugate to any partition $a, b, c\dots, l$, the most expeditious method is find n_i, the number of the elements in the partition not less than i: $n_1, n_2,\dots, n_l$ (l being supposed to be the largest value of any element) will then be its opposite.

Thus, *ex. gr.*, for the partition 5 3 3 1 1, $n_1=5$, $n_2=3$, $n_3=3$ $n_4=1$, $n_5=1$, and $n_1\,n_2\,n_3\,n_4\,n_5$ reproduces 5 3 3 1 1.

If $2m=12$ we have to find the value of $\frac{4}{1,2,}$ which is again 3, and the 3 self-conjugate or self-opposite partitions of 12 will be seen to be 4 4 2 2; 5 3 2 1 1; 6 2 1 1 1 1.

In M. Faà de Bruno's tables of symmetric functions, which are only complete for the case of equations of not higher than the 11th degree, the number of self-conjugate partitions which appear among the headings and sidings of the tables is either 1 or 2, and it was therefore reasonable to try the effect of making arrangement of the partitions such as to bring the self-conjugate or pair of self-conjugate partitions into the centre of the line or column; but as soon as that degree is passed such a kind of principle (the rule founded upon which M. de Bruno does not state) becomes *prima facie* inapplicable at all events without undergoing modifications of which at present we know nothing.

Thus M. de Bruno's tables end just where his proposed principle of arrangement becomes inapplicable, stopping short at the case of the 12th degree, which has since been tabulated by Mr. Durfee in the *American Journal of Mathematics.*

The terms "opposite" or "conjugate" is used by Mr. Durfee in the sense in which I am in the habit of employing it to signify the relation between what M. Faà de Bruno calls *combinaisons associées.* I think it right to recall attention to the fact that the credit of calling into being this kind of conjugate relation, is due to Dr. Ferrers (the present Master of Gonville and Caius College, Cambridge), who some 30 years ago or more was the first to apply it to obtain an intuitive proof of Euler's great law of reciprocity, the very same as that which I have here employed to transform Mr. Durfee's theorem. Euler demonstrated his law by help of his favorite instrument of generating functions.

By instituting in the case of combinations of *unrepeated* elements quite another and more exquisite kind of conjugate relation applicable to all such with the exception of those which belong to the infinite succession 1, 2, 23, 34, 345, 456, 4567, 5678, Mr. Franklin, of this University, succeeded in finding an instantaneous demonstration of another well known but very much more recondite theorem in partitions, also due to Euler, expressible by the statement that the indefinite product

$$(1-x)(1-x^2)(1-x^3)(1-x^4)\ldots$$

has for its development

$$1-x-x^2+x^5+x^7-x^{12}-x^{15}+x^{22}+x^{26}\ldots,$$

where the indices are the complete series of direct and retrograde pentagonal numbers.

On Crocchi's Theorem, by F. Franklin.

[Remarks made in connection with Prof. Sylvester's communication to the University Mathematical Society, October 18, 1882. See Circular No. 19].

The equation

$$ih_i = h_{i-1}\sigma_1 + h_{i-2}\sigma_2 + h_{i-3}\sigma_3 + \ldots\ldots + \sigma_i$$

can be immediately proved as follows. In the second member of the above equation, the term $a^rb^sc^t\ldots.$ will evidently appear as many times as there are ways of producing it by multiplication of a lower combination by any power of any letter; that is, $r+s+t+\ldots.,=i$ times. This proves the equation. And since this equation differs from the well-known equation between s and σ only in the sign of the even-suffix σ's, Crocchi's theorem is proved.

The equation just referred to, viz.:

$$is_i = s_{i-1}\sigma_1 - s_{i-2}\sigma_2 + s_{i-3}\sigma_3 - s_{i-4}\sigma_4 + \ldots\ldots \pm \sigma_i$$

can be proved in a similar manner. In $s_{i-1}\sigma_1$, every elementary combination of the degree i occurs once for each letter it contains, that is, i times in all; and obviously the only other combinations that appear in the second member of the equation are those of the form $a^rbcd\ldots.$; but since the term $a^rbcd\ldots.$ appears once in $s_{i-r}\sigma_r$ and once in $s_{i-(r-1)}\sigma_{r-1}$ and nowhere else, all such terms cancel each other: which proves the equation.

CHEMISTRY.

On White Phosphorus, by Ira Remsen.

[Abstract of a paper read at the University Scientific Association, November 1, 1882].

In some experiments which the author with Mr. E. H. Keiser has been conducting for some time past on the action of phosphorus on moist air, it became necessary to prepare pure phosphorus. For this purpose ordinary phosphorus was distilled in an atmosphere of pure hydrogen and the vapor condensed by being brought in contact with cold water. Under these circumstances, it is deposited in the form of a snow-white, light, plastic mass which differs markedly in appearance and general physical properties from ordinary phosphorus. When this white phosphorus is placed on a piece of bibulous paper and the moisture thus absorbed from it, the mass melts and is transformed into ordinary phosphorus without taking fire. The same transformation takes place when the white material is heated in water to the melting point of ordinary phosphorus. Mr. Keiser will continue the experiments for the purpose of showing, if possible, what relation exists between ordinary phosphorus and the white variety. It may be that this relation is of the same kind, as that which exists between "flowers of sulphur" and "roll brimstone," though the differences in the properties are much more marked in the former than in the latter case.

BIOLOGY.

Observations on the Mean Pressure and the Characters of the Pulse Wave in the Coronary Arteries of the Heart, by H. Newell Martin and W. T. Sedgwick.

[Abstract of a paper (with 3 plates) in the Studies from the Biological Laboratory, Vol. II, No. 3; reprinted from the Journal of Physiology].

The object of the authors was by a critical experiment to endeavor to settle the long disputed point whether the aortic semilunar valves close the mouths of the coronary arteries during the systole of the left ventricle of the heart. If the valves act in this way the pulse wave in the coronary arteries of the heart must differ essentially both in form and in the period of its maximum intensity from the corresponding wave in the carotid artery. Simultaneous tracings taken in a branch of the left coronary artery and in a carotid artery agree in every respect. Hence the Thebesius-Brücke doctrine as to the closure of the orifices of the coronary arteries during ventricular systole, and as to the resulting "Selbst-steurerung" of the heart must be definitely abandoned.

The Influence of Digitaline on the Work done by the Heart of the Slider Terrapin. (*Pseudemys rugosa.* Shaw), by H. H. Donaldson and Maotier Warfield.

[Abstract of a paper in the Studies from the Biological Laboratory, Vol. II, No. 3].

These experiments were undertaken as a preliminary to investigations as to the action of this drug upon the heart of the Mammal. The results of previous observers were so contradictory and open to so many objections that a fresh study of the action of the drug upon the hearts of cold blooded animals seemed desirable before proceeding to work with the hearts of dogs or rabbits.

The chief results are: (1). When the heart is doing normal work digitaline decreases that work. (2). There is a rough relationship between the size of the dose and the extent of the decrease. (3). With small doses of digitaline the pulse rate is at first increased. (4). The diminution in the heart's work is much more dependent on the strength of the dose at any given time than on the total amount of the drug administered. A large amount given in several hours has much less effect than a smaller amount given in a few minutes. Therefore the theory that digitaline has a cumulative action lacks experimental confirmation.

On a New Form of Pilidium, by E. B. Wilson.

[Abstract of a paper (with 1 plate) in the Studies from the Biological Laboratory, Vol. II, No. 5].

The specimens on which this paper is based were obtained at the Marine Laboratory of the University in the summer of 1880. Though clearly belonging to the *Pilidium* group, they were very unlike any hitherto described species. Rabl has in a well known theory ascribed the radiate structure of many adult animals to rotatory movements of the embryo. Dr. Wilson's specimens show that this is not a tenable doctrine, as the larvæ observed while exhibiting marked rotatory movements gave rise to bilateral adults.

On the Polar Effects upon Nerves of Weak Induction Currents, by Henry Sewall.

[Abstract of a paper in the Studies from the Biological Laboratory, Vol. II, No. 3].

The paper deals with the influence of very weak induction currents passing between one pair of electrodes on the irritability of the nerve, as shown by variations in the extent of submaximal muscular contractions, due to stimulation by another pair of electrodes. The results cannot well be summarized; they prove that marked polar (analectrotonic and kathelectrotonic) effects can be produced by induction currents.

Researches on the Growth of Starch Grains, by A. F. W. Schimper.

[Abstract of a paper (with 1 plate) in the Studies from the Biological Laboratory, Vol. II, No. 3].

These researches, (which are translated from the *Botanische Zeitung*, 1881, Nos. 12, 13, 14), were carried on in the Biological Laboratory of the Johns Hopkins University. They prove that the phenomena of growth in starch granules, observed by Naegeli and on which he based his well known doctrine of growth by intussusception, can all be better explained in another manner; and bring forward new arguments supporting the doctrine of growth by surface deposition. They consequently tend to modify essentially the doctrine at present prevailing as to the mode of growth of vegetable cell walls.

Some Observations upon the Form of the Pulse Wave and the Mean Arterial Pressure in a Dog with Patent *Ductus Arteriosus*, by W. H. Howell and F. Donaldson, Jr.

[Abstract of a paper in the Studies from the Biological Laboratory, Vol. II, No. 3].

These observations were made on a dog about to be killed when it was noticed that its cardiac action was abnormal. Professor Frank Donaldson, of the University of Maryland, examined the animal and found the pulse rate greater and the cardiac impulse more marked than in normal dogs; also, the apex of the heart extended much farther to the left, showing marked hypertrophy. Over the whole cardiac region he observed a loud rasping cardiac murmur with the maximum of intensity over the base; also a slight murmur with the second round. Subsequent experiments made on the dog showed a normal arterial pressure, and no abnormality in sphygmo-graphic tracings, except an unusually marked dicrotism.

Professor McLane Tiffany, of the University of Maryland, made the post-mortem on the animal, and found that the *ductus arteriosus* had remained open; its calibre being at least equal to that of either pulmonary artery.

It is a fact of much interest that with such free communication between aortic and pulmonary circulations so good an average arterial pressure (as measured in the femoral artery) was maintained. It can only be explained by assuming (1) a compensatory increase in the force of the heart-beat; (2) an increase in the resistance of the pulmonary circuit; or (3) an increase in the total bulk of blood in the body. Whichever of these agencies was the effective one, the case is one of great interest, as indicating the power of the animal body to adapt itself to unusual conditions of life. So far as the authors could discover only one similar case was previously on record.

On Variations of Reflex-excitability in the Frog, Induced by Changes of Temperature, by W. T. Sedgwick.

[Abstract of a paper in the Studies from the Biological Laboratory, Vol. II, No. 3].

In this paper, the author points out that the work of previous experimenters which seemed to shew that indirect heating of the frog's heart diminished its functional activity involves essential errors, inasmuch as the nutrition of the heart by a flow of blood through it was not properly taken into account. He also proves that the corollary from the work of the above experimenters, viz: that indirect heating of the spinal cord, (within the limits of its physiological working), might diminish its functional activity has no sound experimental basis; and he shows that much more regard must be paid as to the influence of temperature and of drying of the skin upon the reflexes of the frog, than has been paid hitherto, if any satisfactory conclusions are to be reached.

On the Influence of Variations of Intracardiac Pressure upon the Inhibitory Action of the Vagus Nerve, by Henry Sewall and Frank Donaldson, Jr.

[Abstract of a paper in the Journal of Physiology, Vol. III, pp. 357-368].

Working on the hearts of frogs and terrapins the authors find (1) when the whole heart is employed, increases of venous pressure, arterial being constant, weaken the cardio-inhibitory action of the vagus. Thus confirming the results of Ludwig and Luchsinger.

2. Variations of intraventricular systolic pressure within wide limits have no perceptible effect on the vagus activity.

3. Variation of diastolic intraventricular pressure when uncomplicated by simultaneous variation in auricular pressure has no effect.

They therefore conclude that changes of intracardiac pressure when experienced by the ventricle alone are without effect on the cardio-inhibitory function of the vagus.

4. Variations of pressure within sinus and auricles, the ventricle being entirely separated from them, give the same results as when venous pressure is varied in the complete heart.

5. The effect of variations of pressure within the venous sinus, all the rest of the heart being excluded, is such that raised pressure diminishes the cardio-inhibitory action.

The paper concludes with some general considerations on the manner according to which the vagus exerts its inhibitory action upon the heart.

A Discussion of Recent Researches in Europe on the Lower Organisms and their connection with Infectious Diseases, by W. T. Councilman.

[Abstract of a paper read at the University Scientific Association, November 1, 1882].

We assume that the infectious diseases are caused by the entry of a *materies morbi* into the organism. That this *materies morbi* is a living organism in every case, appears to be proven by experiments which show that it is a substance which is insoluble and capable of increase. We know that it is a substance because it clings to inert objects and can thus be transported from one place to another or kept any length of time without losing its power; a blanket from a small-pox patient, for example, can be transported thousands of miles and then produce the disease. Chaveau's experiments with vaccine lymph and the experiments which Davaine made with the blood of splenic fever show that it is insoluble. Of all soluble poisons we know that their virulence decreases in a regular ratio with their dilutions, on the other hand no amount of dilutions, seems to take away entirely the infectious properties of the blood of animals affected with splenic fever; Davaine having succeeded in producing the disease after the blood was diluted 1,000,000 times. The disease when produced by such diluted virus differs not at all from that produced from the undiluted virus. That it has the power of increasing is shown from the fact that having introduced one of the spores of the *Bacillus anthracis* into the circulation of a mouse, in a few hours, the whole vascular system will be filled with the bacilli. Now having an insoluble substance with this power of increasing, of growing, it must be a living organism; it is possible for a soluble substance in a purely chemical manner to produce its like, to increase, but if a granule multiplies indefinitely it must divide and the divided pieces must grow. In quite a number of the infectious diseases we find either in the blood or in the pathological lesions a certain organism, and know that on inoculating animals with the tissues containing these organisms an identical disease will be produced. In order to prove that it is the organisms alone that are infectious it is necessary to isolate them completely from the tissues or fluids with which they are associated, and produce the disease by inoculation of the organisms alone. This can be done by the so-called pure culture, by growing the organisms outside of the body and transferring them from one nutrient substance to another until we know that we have them perfectly pure. In the case of splenic fever, tuberculosis, and some other diseases this has been done, while in other diseases, although we always find a certain definite organism associated with the disease, the strict objective proof that the organism is the cause of the disease is wanting because we are not able to produce the disease on the lower animals by innoculation of the isolated organisms, nor indeed in any other way. Animals show a perfect immunity to a number of our diseases. The benefits which we have derived both in prophylaxis and therapeutics, from these additions to our knowledge are great and are daily increasing.

PHILOLOGY.

A Search for Functional or Dialectic Differences in the Present Systems of the Veda, by M. Bloomfield.

[Abstract of a paper read at the University Philological Association, November 3, 1882].

The discussion began with pointing out the importance both to Sanskrit grammar and to general Indo-European grammar, of the question whether there are to be discovered in the earliest Veda any traces of a difference of use, functional or dialectic, among the present-stems—often two or three, and sometimes numerous—found to occur there from the same root. Some leading facts in the case were reviewed: the (including intensives) dozen or more present-stems of the root *tar* (*tar—tir—tur*); the six from *pi—pyā;* the five from *iṣ*, *hū* and others. A part of these formations are evident results of transition from one system to another, brought about by some form or forms derivable from more than one stem. In other cases an isolated present-form is due to the influence of a similar formation from some other root occurring along with it. Yet it must be granted that, in all the languages of the family the same root not infrequently makes present-stems with different formative elements. We might naturally look to find the cause of this either: 1, in an original functional difference of the various formations—a variety of temporal or modal use; of causal, factitive, continuative, intransitive use, or the like; or 2, in the dialectic or stylistic habit of different localities or literary compositions.

The results of the investigation, though negative in the main, offer several interesting facts. The root *bhar* shows a distinct and almost unique functional difference between its two stems *bhára-* and *bibhar-*: the former being in the terminology of Slavic grammar "perfective," regularly followed by the dative and best rendered by 'convey;' while the "imperfective" *bibhar-* is used without the dative and means 'support.' Typical examples are *bhára gṛṇaté vásūni*, "bring good things to the singer," (RV., IX, 69, 10); and *bibhárṣi vásu hástayos*, "thou bearest wealth in thy hands," (RV., I, 55, 8). But all other reduplicated presents were looked through and compared with other present-systems without any positive results.

In one present-stem from the root *tar*, namely *túrva-*, there is to be noted an occasional causative value: *e.g.*, RV., VI, 50, 10. The same causative force is very apparent in *júrva-*, and *dhúrva* may also be causative. A like tendency seems to be observable in stems of the type *jínva-*. This stem, as well as the more original *jínu-*, is readily explainable as causative of 1 *ji*, and signifying "cause to prosper." The stem *ínva-* has a like causal force, and examples of the more primitive *ínu* are used in the same manner. Less convincing is the same tendency in the stems *pínva*, *ṛṇvá*, *hínva*. Further also the stems *dhinu*, *sunu-* and *mṛṇa* can be offered as examples for causative value, while the remaining *nu*-presents yielded no such result.

In the *ya*-class (or *dīv*-class) is seen a marked tendency toward intransitive, reflexive, or even passive function; on the other hand the *ch*-class yielded no results, which could be formulated satisfactorily. In the remaining conjugation-classes also enough material was collected and examined to put beyond question the fact that there is nowhere any specialization of the use of a class, in any way that should help us to a conception of the original value of its class-sign.

A search for traces of dialectic use was also undertaken and carried far enough to show that it would doubtless continue to be fruitless, so far as the present-stems are concerned. A number of prominent roots were made the basis of the investigation, and their present-stems numbered as found distributed among the books of the Rig-Veda, in order to see whether a given book employed a given stem, or more than one, with such predilection that it might be presumed due to dialectic tendencies. But absolutely no such tendencies came to light.

On Mr. Matthew Arnold's Poetry Test, by W. J. Alexander.

[Abstract of a paper read at the University Philological Association, November 3, 1882].

This was a defence against recent criticism of the practical test for poetry, put forward by Mr. Arnold in his Introduction to "Ward's English Poets" (pp. xxv and cf.). The defence was based on an examination of the foundation and method of literary judgments in general. Attention was then drawn to the conditions and limitations which Mr. Arnold imposes upon his test, and thus it was shown that his method is precisely analogous to the more general one already investigated. The two meth
were found to differ from one another only in the breadth or narrowi
of the basis on which they rest, and Mr. Arnold's advocacy of the narro
was justified by a consideration of the circumstances of the Introducti
Finally, some peculiarities of Mr. Arnold's style were pointed out,
were held accountable for a considerable part of the hostile criticism wh
his test had invoked.

On the use of ὅτι (or ὡς) in Direct Quotations, by E. H. Spiek

[Abstract of a paper read at the University Philological Association, November 3, 1

In this paper only such cases were considered as show some form
the 1st or 2nd person and are thus clearly direct quotations, cases of cha
of construction from indirect to direct were not treated, as the feelin
not the same. The use first appears in Herodotus (II. 115). Of
orators, (except Hyperides) Antiphon, Isaeus, and Lycurgus have
examples, the others vary between one and four, except Demosthe
who uses it more frequently than all the others combined, most of
cases occurring in the public speeches. Thucydides uses it a few tin
and Plato and Xenophon quite often. Two evident cases of ὡς int
ducing direct quotations were noticed in Dinarchus, viz, I. 12. and I. 1
Of this use Kühner says: '(selten ὡς),' giving no examples, while Krü
simply adds after ὅτι: '(nie ὡς).' To these examples from Dinarc
may be added Dem., XII. 151. In later Greek we find ὡς so used in Pl
Them., c. ii; possibly it occurs there oftener, but it is a rare use at b
The usual form with ὅτι also appears later, *e. g.*, New Testament: Ma
5. 35; Luke; 8. 49, &c.

HISTORICAL AND POLITICAL SCIENCE.

Introduction to American Institutional History, by Edward Freeman. (A special contribution growing out of his rec lectures in Baltimore).

[Abstract of an article read in the Historical Seminary, October 6, 1882, and printe the first number of the "Studies in Historical and Political Science."]

The institutions of Massachusetts or Maryland, such at least amo
them as have been handed down from the foundation of those coloni
are not simply the institutions of Massachusetts and Maryland. Th
are part of the general institutions of the English people, as those
again part of the general institutions of the whole Aryan family. T
history of a Massachusetts township or a Maryland manor becomes
looked at in a scientific spirit, part of the general history of the wo
The scientific view of such matters consists mainly in dealing with th
by the comparative method. We do not rightly understand the hist
of our people on either side of Ocean, unless we take in the close analo
between the English settlements in Britain in the fifth and sixth centuri
and the English settlements in America in the seventeenth century. T
likeness comes out most strongly if we contrast either with the Norm
Conquest in England or with the Spanish Conquests in America. Th
again differ greatly from one another; but they agree in the compa
tively short time in which the work was done. In both of them sett
ment took the form of conquest, and of conquest on a great scale. I
those who came in the three keels of Hengest and those who came in t
Mayflower were both of them in a different position. They settled
small communities and won the land bit by bit. They brought with th
the institutions of their elder country; they planted them afresh, a
what they planted grew up with such changes as were wrought by t
nature of the new soil in which it was planted. The most notable thi
of all, yet surely the most natural thing of all, is that the New Engla
settlers of the seventeenth century largely reproduced English institutic
in an older shape than they bore in the England of the seventeenth ce
tury. They gave a new life to many things which in their older ho
had well nigh died out. They reproduced in many points the state
things in old Greece and in mediaeval Switzerland. A New Engla
town-meeting is essentially the same thing as the Homeric ἀγορή, t
Athenian ἐκκλησία, the Roman *comitia*, the Swiss *Landesgemeinde*, t
English folk-moot. The circumstances of New England called the pri
itive assembly again into being when in the older England it was w
nigh forgotten. What in Switzerland is a *sur*vival was in New Engla
rather a *re*vival.

I noticed in Virginia, the only one of the Southern States of which I have seen anything, that I heard the word *county* at least a hundred times for once that I heard it in New England. The merest glance at the two countries shows that, setting aside the results of late events, the whole political organization of the two countries is different. Both have reproduced English institutions; but they have not reproduced the same English institutions. I suppose that Virginia and New England must be the most strictly English parts of the United States; the mixture of any foreign element in the original settlement must have been very small in either. But the two lands represent two different sides of England. Virginia more nearly reproduced the England of the time of the settlement. New England more nearly reproduced the England of an earlier time.

The Past and the Present of Political Economy, by R. T. ELY.

[Abstract of principal paper read before the Historical and Political Science Association, October 20, 1882].

In 1876, the centennial of Adam Smith's "Wealth of Nations" was celebrated. This event, though noteworthy for the reason that at that time the "Wealth of Nations" was the only book which had ever been thus honored, has a greater significance than could be attached to a merely formal commemoration. It marked an era in the development of social and economic science. On that occasion were elicited expressions of dissatisfaction with the methods and dogmas of the Manchester men, and there was also disclosed, more prominently than hitherto in England, the existence of a new and rising school of Political Economy, directly opposed upon points of both theory and practice to the orthodox English system. Side by side with the declaration of an ardent disciple, that Adam Smith had securely established a "deductive and demonstrative science of human actions and conduct," came the announcement of a distinguished Belgian professor, that a more advanced method of investigating economic problems had already been instituted, whose groundworks were history and statistics.

The Political Economy of Malthus, Ricardo, and James Mill, all of whom were extreme followers of Adam Smith, was almost universally received as the only true doctrine, until some thirty years ago. The teachings of these men were comparatively simple, and consisted of a few leading principles drawn from *à priori* hypotheses. Their leading assumptions were the universal selfishness of man, and his love of ease. They further assumed that wages and profits were equal, and advocated a let alone policy for all governments, in relation to questions of a social and economic nature. According to their view, Political Economy was a comparatively simple study. It was only necessary to keep in mind a few general laws and then all economic phenomena could be easily classified and fully understood. Legislators too were furnished with an infallible guide of conduct in the tenet of "*laissez-faire, laissez passer.*" It was not necessary for government to interfere in behalf of the lower classes, as Nature provided abundantly for them. The capital of the country was equitably distributed, the wage-fund going to the laborer and the profits to the capitalist. The possible existence of an unfair distribution of wealth was ignored. Some economists went so far as to speak of a "so-called poor man." Every thing was as it should be, and the highest good of society was best promoted by the individual, self-interested action of each member.

A merit of this system was, that it separated wealth from other social phenomena for separate study. It showed the impossibility of understanding society without investigating the process of the production and distribution of economic goods. It served an important purpose in pulling down old and worn-out institutions, which, by prolonged retention, had become barriers to progress. According to the acknowledgment of Baron vom Stein, the "Wealth of Nations" furnished him with the basis of the sweeping and beneficial reforms which he inaugurated in Prussia. It was instrumental in introducing international free trade in England. It did a good work, but its action was purely a negative one. It served a similar purpose to the French Revolution, being powerful to pull down but powerless to reconstruct. It answered satisfactorily the needs of the latter part of the eighteenth and the earlier part of the nineteenth centuries.

Its leading assumptions were, however, largely false. No man is entirely selfish. This is proved by numerous facts of every-day life as, *e. g.*, that during the late "hard times" many manufacturers continued their business primarily, for the sake of affording employment to workmen who who would otherwise have been sorely distressed. While competition has a powerful influence in regulating wages, it does not, even in the majority of cases, reduce them to the lowest possible limit. This is shown upon competent statistical authority. In regard to selfishness being the motive power of the masses, national honor, devotion to principle and the altruistic sentiment of wishing to benefit one's kind are strongly counteracting influences. The doctrine of the equality of wages and profits does not stand the test of experience. Neither are taxes so shifted as to be divided fairly between different employments. A non-intervention state policy has proved a complete failure. It has not been carried out even in England. The circumstances which compelled the passage of the Factory Act, the regulations regarding the employment of labor, the reforms in the Irish land laws and the introduction of a system of compulsory education, show how entirely foreign to the spirit of true progress is the tenet of "*laissez-faire.*"

The Political Economy of the Manchester school was attacked by Müller, Sismondi, List, Carey, and others; but no successful attempt was made to establish a new system until about 1850. At that time the writings of Hildebrand, Kneis, and Roscher, three young German professors, began to attract attention. They inaugurated a new method of investigating economic problems somewhat analogous to that used in the various departments of Physical Science. In their view the history of the world had been a series of great economic experiments. They held that these should be studied in connection with accurate statistical data from the present. The results could then be generalized into laws, not final and unvarying for all countries and all times, but which must be continually modified by experiences gathered from fresh statistics. Hence the new school of Political Economy has been called the Historical—also Experimental, Statistical, and Comparative. Political Economy is regarded by the adherents of this method as only one branch of social science, viz., that which deals with social phenomena from an economic standpoint. They view it in the light of a growth, a development, and much significance is attached to time and historical environment. They do not assume that there is one universal economic policy for all countries, but rather that there is a national economy applicable to each. This school insists strongly upon the moral basis of Political Economy, and regards man and not wealth as the factor of leading importance to be considered. It aims continually at the elevation of mankind, and especially of the lower classes. It gives unceasing attention to the problem of the equitable distribution of economic goods, watches the increasing power of large corporations and wealthy monopolists, and counsels the fostering care of governments, when their intervention is needed, to protect the weak or to promote the efficiency of any great engine of social progress.

This school has gained most ground in Germany, where it is now the dominant system. It has made considerable progress in other countries, and is represented in England by Cliffe-Leslie, Thorold Rogers and the late Stanley Jevons having considerable sympathy with it; in Belgium, by de Laveleye; and in Italy, by Cossa, Lampertico, and Luzzati; in America, one finds in the writings of Francis A. Walker the independence and vigor characteristic of this school. It indicates the tendency of modern thought upon social and economic questions.

Political Economy in Germany in 1882, by R. T. ELY.

[Abstract of principal paper read before the Historical and Political Science Association, November 17, 1882].

The three most prominent events in the history of Political Economy in Germany during the present year have been the appearance of a new and complete text-book of the science, edited by Prof. Schönberg, of the University of Tübingen, the meeting of the Economic Congress (der volkswirthschaftliche Congress) in September, and the assembly of the Union for Social Politics (der Verein für Socialpolitik) in Frankfort-on-the-Main in October.

The Economic Congress was founded in 1858 by Prince-Smith, an Englishman by birth, Faucher, Victor Böhmert, Max Wirth, and Michaelis. Followers of Adam Smith, as developed and interpreted by Bastiat, they opposed all interference of government in economic affairs, holding with the latter that "the action of government is essentially limited to the maintenance of order, security, and justice, and that all

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Winslow, F.	*Graduate.*	*Marine Laborator*
Witzenbacher, W. J.	*Matriculate.*	54 McCulloh S
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Wood, H.	*Associate.*	67 Oak S
Woodworth, C. L.	*Instructor.*	181 Linden A
Wright, C. R.	*Graduate.*	54 McCulloh S
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Yonce, G. V.	*Graduate.*	Luthervill
Zweizig, J. H.	*Graduate.*	162 Franklin S

(A). Not now in attendance on the University.

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Consultation Hours.

In order to promote economy of time, on the part of students as well as officers, brief consultations may be had with the gentlemen below-named at the hours and places indicated. In case prolonged conference is desirable, special appointments may be made, by notes exchanged at the registrar's office, or otherwise. The person named will usually be accessible for some minutes after the appointed hour. The appointments do not include Saturday.

Gilman, D. C.	*President's Office.*	1 p. m.
Adams, H. B.	*Registrar's Office.*	9 a. m.
Bloomfield, M.	123 *W. Madison St.*	2 p. m.
Bright, J. W.	111 *W. Monument St.*	(Except Wed.) 12 m.
Brooks, W. K.	*Biological Laboratory.*	11 a. m.
Browne, W. H.	*Library.*	9 a. m. to 5 p. m.
Coale, R. D.	*Chemical Laboratory.*	10 a. m.
Craig, T.	*Room* 18.	4 p. m.
Ely, R. T.	118 *W. Monument St.*	1 p. m.
Elliott, A. M.	111 *W. Monument St.*	1 p. m.
Franklin, F.	*Room* 18.	12 m.
Gildersleeve, B. L.	181 *Howard St.*	11 a. m.
Hastings, C. S.	*Room* 5.	11 a. m.
Jameson, J. F.	118 *W. Monument St.*	(Tues. and Thurs.) 3 p. m.
Martin, H. N.	*Biological Laboratory.*	12 m.
Marcou, P. B.	111 *W. Monument St.*	1 p. m.
Morris, C. D.	181 *Howard St.*	11 a. m.
Morris, G. S.	187 *Howard St.*	1 p. m.
Morse, H. N.	*Chemical Laboratory.*	2 p. m.
Newell, H.	*Hopkins Hall.*	(Mon. and Friday) 2.15 p. m.
Peirce, C. S.	187 *Howard St.*	(Tues. and Thurs.) 4.30 p. m.
Rabillon, L.	187 *Howard St.*	12 m.
Remsen, I.	*Chemical Laboratory.*	11 a. m.
Rowland, H. A.	*Physical Laboratory.*	9 a. m.
Sedgwick, W. T.	*Biological Laboratory.*	12 m.
Spieker, E. H.	181 *Howard St.*	10.45 a. m
Story, W. E.	*Room* 15.	12 m
Sylvester, J. J.	*Room* 17.	2 p. m
Warren, M.	181 *Howard St.*	12 m
Wood, H.	111 *W. Monument St.*	1 p. m
Woodworth, C. L.	*Hopkins Hall.*	10 a. m. to 1 p. m

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The Janitor, when not about the building, may be found at 111 W Monument St.

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Library and Laboratories.

The Library is open daily, including Saturday, from 9 a. m. to 10 p. m.

The Biological, Chemical, and Physical Laboratories are open daily, except Saturday, from 9 a. m. to 5 p. m.

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CALENDAR, 1882–83.

Tuesday, September 19.	**Current Academic Year Began.**
Friday, December 22—Tuesday, Jan. 2.	**Christmas Recess.**
Tuesday, January 2.	**Mr. F. Seymour Haden's Lectures on Etching Begin. (See p. 36).**
Wednesday, January 3.	**Meeting of Scientific Association, 8 P. M.**
Friday, January 5.	**Meeting of Philological Association, 12 M.**
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Wednesday, January 10.	**Professor Corson's Course on Poetry Begins. (See p. 36).**
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MATHEMATICS.

On the Fundamental Theorem in the New Method of Partitions, by J. J. Sylvester.

[Abstract of a paper read before the University Mathematical Society, November 15, 1882].

The new method of partitions which I gave to the world more than a quarter of a century ago is an application of a theorem which, I think it must be conceded, is, after Newton's Binomial Theorem, the most important organic theorem which exists in the whole range of the Old Algebra. What Newton's theorem effects for the development of *radical*—that theorem accomplishes for the development of *fractional* forms of algebraical functions.

One (but not the most perfect) form in which it can be presented is the following. If Fx be any proper algebraical fraction in x, whose infinity roots (*i. e.*, the values of x which make Fx infinite) are $a, b, \ldots l$, quantities all supposed to differ from zero then the coefficient of x^n for any value of n will be the residue, *i. e.*, the coefficient of $\frac{1}{x}$ in

$$\Sigma(\lambda^n e^{-nx})F(\lambda e^{-x})\ [\lambda = a, b, \ldots, l].$$

By supposing Fx broken up into proper simple fractions of the form $\sum\frac{fx}{(a-x)^i}$ it is very easy to see that the theorem will be true in general if true for $\frac{fx}{(a-x)^i}$ and from this it is but a step to see that the theorem will be true in general if true for the simplest form of rational function, *i. e*, $\frac{1}{(1-x)^i}$.

All then that remains to do is to show that the coefficient of x^n in this fraction is the same as the coefficient of $\frac{1}{x}$ in $\frac{e^{nx}}{(1-e^{-x})}$ which may be done as follows:

$$\frac{1}{(1-e^{-x})^i} = \left(1-\frac{\delta_x}{1}\right)\left(1-\frac{\delta_x}{2}\right)\left(1-\frac{\delta_x}{8}\right)\ldots\left(1-\frac{\delta_x}{(i-1)}\right)\left(\frac{1}{1-e^{-x}}\right)$$

$$= \left(1 - A\delta_x + B\delta_x^2 - C\delta_x^3 \ldots\right)\left(\frac{1}{x} + \ldots\right)$$

$$= \left(\frac{1}{x} + \frac{A}{x^2} + \frac{1\,2B}{x^3} + \frac{1.2.3C}{x^4} + \ldots\right) + \text{positive powers of } x.$$

Therefore the coefficient of $\frac{1}{x}$ in $\dfrac{1 + nx + \frac{n^2}{1.2}x^2 + \frac{n^3}{1.2.3}x^3 + \ldots}{(1-c^{-b})^i}$.

$$= (1 + An + Bn^2 + Cn^3 + \ldots)$$

$$= \left(1+\frac{n}{1}\right)\left(1+\frac{n}{2}\right)\left(1+\frac{n}{8}\right)\ldots\left(1+\frac{n}{i-1}\right)$$

$$= \frac{(n+1)(n+2)\ldots(n+i-1)}{1, 2, \ldots i} = \text{coefficient of } x^n \text{ in } \frac{1}{(1-x)^i}.\ \text{Q.E D.}$$

This method of proof, however, is not the simplest or best; as soon as we mould the theorem into a form most easily admitting of being expressed in general terms that very form itself suggests a simpler (nay, so to say, an instantaneous) proof, and moreover relaxes an unnecessarily stringent condition in the previous statement of the theorem.

Of course by a finite infinity root of a function no one can fail to understand a value of the variable differing from zero which makes the function infinite. This then is the true statement of the theorem in general terms.

In any proper-fractional function developed in ascending powers of a variable, the constant term is equal to the Residue (with its sign changed) of a sum of functions obtained by substituting in the given function in place of the variable the product of each, in succession, of its finite infinity roots into the exponential of the variable.

That is to say, if the proper-fraction $Fx = \frac{\phi x}{x^i(x-a)^j(x-b)^k\,..(x-l)^m}$ the constant term (with its sign changed) in this fraction developed in ascending powers of x is the same as the Residue of $\Sigma F(\lambda e^x)[\lambda = a,$

To prove this it is only necessary to suppose the fraction Fx sep into simple partial fractions with constant numerators and the th becomes self-evident.*

It follows, therefore, writing n in place of i that the coefficient o ascending-power series for the fraction $Gx = \Big(\frac{\phi x}{(x-a)^j\ldots(x-}$ will be the Residue with its sign changed of $\Sigma(a^{-n}e^{-nx})G(ae^x)$, or is the same thing is the Residue of $\Sigma a^{-n}e^{nx}G(ae^{-x})$ which theor now see is true not merely for the case where G is a proper-fractio is a function of x whose degree is a negative integer but remai when the degree of G is any number inferior to n, for when that co is satisfied $\frac{G}{x^n}$ is a proper fraction, which is all that is required i for the parent theorem to apply.

The Maximum Value of a Certain Determinant, by E. W. I

[Abstract of a paper read before the University Mathematical Society, November 1

The elements of a determinant being restricted to a variation b the limits $-a$ and $+a$, it is found that for all determinants whos is greater than 2, a numerical maximum will be obtained by p the elements $(-a)$ in the principal diagonal and making all the elements of the determinant $+a$. If we denote such a determin order n when $a = 1$ by D_n, and the minor of an element in the i and kth column by A_{ik}, we have always $A_{ii} = D_{n-1}$, $A_{ik} = \frac{-D}{n-}$ that

$$D_n = -\left(1+\frac{n-1}{n-3}\right).\,D_{n-1} = +\left(1+\frac{n-1}{n-8}\right)\left(1+\frac{n-2}{n-4}\right).\,D$$

$$= \pm\left(1+\frac{n-1}{n-8}\right)\left(1+\frac{n-2}{n-4}\right)\ldots\ldots\left(1+\frac{5}{8}\right)\left(1+\frac{4}{2}\right)\left(1+\frac{8}{1}\right).$$

$$= \pm(n-2)2^{n-1}, \text{ since } D_3 = 4.$$

The sign will be ± according as n is $\frac{\text{odd}}{\text{even}}$.

The effect of a change in any element is to lessen the greatest leaving the rest the same.

For the maximum cubic determinant $D_n^{(3)}a^n$, we have merely to all the strata identical and equal to $D_n^{(2)}$. Its value is $\pm n!\,D_n^{(2)}a^n$.

The 4-dimensional determinant may be looked upon as a sort of minant of plane determinants, the terms of the development being determinants of which the plane determinants are the strata. I quasi-determinant the same rule of signs applies as in the ordinary minant and we get for the maximum value accordingly $\pm D_n^{(2)}.n!$ $= \pm n!(D_n^{(2)})^2$.

Similarly,

$$D_n^{(2p)} = \pm(n!)^{p-1}(D_n^{(2)})^p,$$

$$D_n^{(2p+1)} = \pm(n!D_n^{(2)})^p.$$

In any of these determinants we have at once a formula for the mum number of positive terms in the development. This is for D

$$\frac{(n!)^{q-1} \pm D_n^{(q)}}{2}.$$

We use the ± sign according as $D_n^{(q)}$ is ±.

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* It must, however, previously be shown that the residue of $\frac{1}{(1-e^x)^i}$, where positive integer, the same as that of $\frac{1}{1-e^x}$, *i. e.*, is -1; this becomes obvious fr consideration that the change of i into $i+1$ alters the quantity to be residu $\frac{e^x}{(1-e^x)^{i+1}}$, *i. e.*, by the differential derivative of $\frac{1}{(1-e^x)^i}$ divided by i, of wh residue is necessarily zero—that being true for the differential derivative of any s powers of a carrier variable.

Notes on Symmetric Functions, by W. P. DURFEE.

[Abstract of a paper read before the University Mathematical Society, November 15, 1882].

(1). *On Tabulation.*

Faà de Bruno has published in his "Formes Binaires" tables which give the values of the symmetric functions of the roots of an equation in terms of its coefficients. These tables are symmetrical and the units, which are coefficients of the function of the *opposite* or *conjugate* partition, lie in the sinister diagonal, with the exception of those belonging to the self opposite partitions. My object is to show how such an arrangement may be effected for any weight. Let the partitions of 8, for example, be written as follows:—

$$\binom{8}{1^8}\binom{71}{21^6}\binom{6\ 2}{2^21^4}\binom{5\ 3}{2^31^2}\binom{4^2}{2^4}\binom{61^2}{31^5}\binom{521}{321^3}\binom{43\ 1}{32^21}\binom{4\ 2^2}{3^21^2}\binom{3^22}{3^22}\binom{51^3}{41^4}$$

$$\binom{421^2}{421^2}\binom{3^21^2}{4\ 2^2}\binom{32^21}{43\ 1}\binom{2^4}{4^2}\binom{41^4}{51^3}\binom{321^3}{521}\binom{2^31^2}{5\ 3}\binom{31^5}{61^2}\binom{2^21^4}{6\ 2}\binom{21^6}{71}\binom{1^8}{8}$$

The partitions in the upper line are separated into groups containing 1, 2, 3, &c., parts, and in these groups are arranged in dictionary order. The partitions of the lower line are the opposites of those to which they are joined.

Now it is easily shown that a symmetric function represented by a partition in the upper line can contain no function of the coefficients represented by a partition which precedes its opposite in the lower line, and also that a symmetric function represented by a partition in the lower line can contain no function of the coefficients represented by a partition following its opposite in the upper line. It is an easy consequence from what precedes that the desired arrangement will be effected by writing the partitions representing both symmetric functions and combinations of coefficients, in the following order, viz: the first half of the partitions, not counting the self-opposite ones, in the above order; the self opposite partitions without regard to order; the opposites of the first half in inverse order.

It might be well to add that Faà de Bruno has given in Vol. 76 *Comptes Rendus*, a table of the values of the symmetric functions of weight 8, which is symmetrically arranged in a half square. This table contains several errors. The most noticeable are that the coefficient of $a_3^2a_2$ in the value of $\Sigma\alpha^3\beta^3\gamma^2$ and the coefficient of $a_4a_2a_1^2$ in the value of $\Sigma\alpha^4\beta^2\gamma\delta$ are given as zero, while each should evidently be unity. For the weight 8 it is impossible to arrange the table symmetrically and at the same time confine it to a half square, and it is probable that the same thing is true for higher orders.

(2). *Extension of Waring's Formula.*

Waring has given the following formula:

$$\Sigma\alpha^n=\sigma_n=$$

$$n\Sigma(-)^{n+\lambda_1+\lambda_2+\ldots+\lambda_k-1}\frac{\pi(\lambda_1+\lambda_2+\ldots+\lambda_k-1)}{\pi\lambda_1,\pi\lambda_2,\ldots\pi\lambda_k}s_1^{\lambda_1},s_2^{\lambda_2}\ldots s_k^{\lambda_k},$$

where $\lambda_1+2\lambda_2+3\lambda_3+\ldots k\lambda_k=n.$

In this σ_n denotes the sum of the nth powers of the elements, $s_1, s_2, \ldots s_k$, the simple symmetric functions and π the factorial.

Combining this with the well-known formula

$$\mathrm{E}\left(\frac{r+s}{r}\right)\Sigma\alpha^r\beta^s=\sigma_r\sigma_s-\sigma_{r+s},\ (r\geqq s),$$

we obtain

$$\mathrm{E}\left(\frac{r+s}{r}\right)\Sigma\alpha^r\beta^s=\Sigma(-)^{\Lambda+r+s-1}\times$$

$$\frac{(r+s)\pi(\Lambda-1)-rs\Sigma\dfrac{\pi(N-1)}{\pi(\nu_1)\pi(\nu_2)\ldots\pi(\nu_n)}\lambda_1^{(\nu_1)}\lambda_2^{(\nu_2)}\ldots\lambda_n^{(\nu_n)}}{\pi(\lambda_1)\pi(\lambda_2)\ldots\pi(\lambda_k)}s_1^{\lambda_1}s_2^{\lambda_2}\ldots s_k^{\lambda_k},$$

where
$$\Lambda=\lambda_1+\lambda_2+\ldots+\lambda_k,$$
$$N=\nu_1+\nu_2+\ldots+\nu_n,$$
$$\lambda_1+2\lambda_2+3\lambda_3+\ldots+k\lambda_k=r+s,$$
$$\nu_1+2\nu_2+3\nu_3+\ldots+n\nu_n=r,$$

and $\lambda_1^{(\nu_1)}$ signifies $\lambda_1(\lambda_1-1)\ldots(\lambda_1-\nu_1+1)$.

On the Number of Self-Opposite Partitions, by W. P. DURFEE.

[Abstract of a paper read at the University Mathematical Society, October 18, 1882).

A self-opposite or self-conjugate partition may be defined as a partition such that if set out as an array of units, the sums of the columns reproduce the original partition.

$5\,3\,2\,1^2$ for example is a self-opposite partition of 12.

$$\begin{array}{ccccc|c}
1 & 1 & 1 & 1 & 1 & 5\\
1 & 1 & 1 & & & 3\\
1 & 1 & & & & 2\\
1 & & & & & 1\\
1 & & & & & 1\\
\hline
5 & 3 & 2 & 1 & 1 &
\end{array}$$

It is evident that every such array may be looked upon as arranged symmetrically about a square of units (set off in the above illustration by dotted lines) which square must contain an odd or even number of units according as n, the partitioned number, is odd or even, since the number of units outside the square is necessarily even.

If we denote the number of units in the square by q^2, those outside will be $n-q^2$ of which $\frac{1}{2}(n-q^2)$ will be to the right and $\frac{1}{2}(n-q^2)$ below the square. Now the partition will remain self-opposite whatever the arrangement of the $\frac{1}{2}(n-q^2)$ units to the right provided the $\frac{1}{2}(n-q^2)$ units below be arranged symmetrically, but the number of ways of arranging these $\frac{1}{2}(n-q^2)$ units is precisely the number of ways of dividing $\frac{1}{2}(n-q^2)$ into q or fewer parts which I shall represent by $[\frac{1}{2}(n-q^2):q]$. In the example given above $\frac{1}{2}(n-q^2)=4$, so that in addition to the one set out which corresponds to the partition 3 1 12 may have two other self-opposite partitions corresponding to 4 0; 2 2:

$$\begin{array}{cccccc|c}
1 & 1 & 1 & 1 & 1 & 1 & 6\\
1 & 1 & & & & & 2\\
1 & & & & & & 1\\
1 & & & & & & 1\\
1 & & & & & & 1\\
1 & & & & & & 1\\
\hline
6 & 2 & 1 & 1 & 1 & 1 &
\end{array}
\qquad
\begin{array}{cccc|c}
1 & 1 & 1 & 1 & 4\\
1 & 1 & 1 & 1 & 4\\
1 & 1 & & & 2\\
1 & 1 & & & 2\\
\hline
4 & 4 & 2 & 2 &
\end{array}$$

It can have no other since there is no other even square less than 12 to serve as base.

If for the general case we denote the number of self-opposite partitions of n by Pn we shall have $Pn=\Sigma\,[\frac{1}{2}\,(n-q^2):q]$ where the summation sign is to extend to all $\frac{\text{odd}}{\text{even}}$ integer values of q less than $\sqrt{n}$ according as n is $\frac{\text{odd}}{\text{even}}$.

Note on the above, by J. J. SYLVESTER.

Mr. Durfee's very elegant and interesting theorem above given may, by help of Euler's law of reciprocity, be expressed in the following terms.

Let fx and ϕx represent respectively:

$$\frac{1}{1-x}+\frac{x^4}{(1-x)(1-x^2)(1-x^3)}$$
$$+\frac{x^{12}}{(1-x)(1-x^2)(1-x^3)(1-x^4)(1-x^5)}+\ldots$$
$$+\frac{x^{2i^2+2i}}{(1-x)\ldots(1-x^{2i+1})}+\ldots;$$

and
$$\frac{x^2}{(1-x)(1-x^2)}+\frac{x^8}{(1-x)(1-x^2)(1-x^3)(1-x^4)}+\ldots$$
$$+\frac{x^{2i^2}}{(1-x)\ldots(1-x^{2i})}+\ldots,$$

then the number of self-conjugate partitions of $2m+1$ and of $2m$ are the coefficients of x^m in the ascending expansions of fx, ϕx, respectively.

Thus, suppose $2m+1=13$, the coefficient of x^6 in fx developed, *i. e.*, $\frac{6}{1,}+\frac{2}{1,2,}$ or 3 is the number of self-conjugate partitions of 13.

These will be found to be 7 1 1 1 1 1 1, 4 4 3 2, 5 3 3 1 1. To find the conjugate to any partition $a, b, c\ldots, l$, the most expeditious method is find n_i, the number of the elements in the partition not less than i: $n_1, n_2, \ldots, n_l$ (l being supposed to be the largest value of any element) will then be its opposite.

Thus, *ex. gr.*, for the partition 5 3 3 1 1, $n_1=5$, $n_2=3$, $n_3=3$ $n_4=1$, $n_5=1$, and $n_1\,n_2\,n_3\,n_4\,n_5$ reproduces 5 3 3 1 1.

If $2m=12$ we have to find the value of $\frac{4}{1,2,}$ which is again 3, and the 3 self-conjugate or self-opposite partitions of 12 will be seen to be 4 4 2 2; 5 3 2 1 1; 6 2 1 1 1 1.

In M. Faà de Bruno's tables of symmetric functions, which are only complete for the case of equations of not higher than the 11th degree, the number of self-conjugate partitions which appear among the headings and sidings of the tables is either 1 or 2, and it was therefore reasonable to try the effect of making arrangement of the partitions such as to bring the self-conjugate or pair of self-conjugate partitions into the centre of the line or column; but as soon as that degree is passed such a kind of principle (the rule founded upon which M. de Bruno does not state) becomes *prima facie* inapplicable at all events without undergoing modifications of which at present we know nothing.

Thus M. de Bruno's tables end just where his proposed principle of arrangement becomes inapplicable, stopping short at the case of the 12th degree, which has since been tabulated by Mr. Durfee in the *American Journal of Mathematics*.

The terms "opposite" or "conjugate" is used by Mr. Durfee in the sense in which I am in the habit of employing it to signify the relation between what M. Faà de Bruno calls *combinaisons associées*. I think it right to recall attention to the fact that the credit of calling into being this kind of conjugate relation, is due to Dr. Ferrers (the present Master of Gonville and Caius College, Cambridge), who some 30 years ago or more was the first to apply it to obtain an intuitive proof of Euler's great law of reciprocity, the very same as that which I have here employed to transform Mr. Durfee's theorem. Euler demonstrated his law by help of his favorite instrument of generating functions.

By instituting in the case of combinations of *unrepeated* elements quite another and more exquisite kind of conjugate relation applicable to all such with the exception of those which belong to the infinite succession 1, 2, 23, 34, 345, 456, 4567, 5678, Mr. Franklin, of this University, succeeded in finding an instantaneous demonstration of another well known but very much more recondite theorem in partitions, also due to Euler, expressible by the statement that the indefinite product

$$(1-x)(1-x^2)(1-x^3)(1-x^4)\ldots$$

has for its development

$$1-x-x^2+x^5+x^7-x^{12}-x^{15}+x^{22}+x^{26}\ldots,$$

where the indices are the complete series of direct and retrograde pentagonal numbers.

On Crocchi's Theorem, by F. Franklin.

[Remarks made in connection with Prof. Sylvester's communication to the University Mathematical Society, October 18, 1882. See Circular No. 19].

The equation

$$ih_i = h_{i-1}\sigma_1 + h_{i-2}\sigma_2 + h_{i-3}\sigma_3 + \ldots\ldots + \sigma_i$$

can be immediately proved as follows. In the second member of the above equation, the term $a^r b^s c^t \ldots\ldots$ will evidently appear as many times as there are ways of producing it by multiplication of a lower combination by any power of any letter; that is, $r+s+t+\ldots\ldots, = i$ times. This proves the equation. And since this equation differs from the well-known equation between s and σ only in the sign of the even-suffix σ's, Crocchi's theorem is proved.

The equation just referred to, viz.:

$$is_i = s_{i-1}\sigma_1 - s_{i-2}\sigma_2 + s_{i-3}\sigma_3 - s_{i-4}\sigma_4 + \ldots\ldots \pm \sigma_i$$

can be proved in a similar manner. In $s_{i-1}\sigma_1$, every elementary combination of the degree i occurs once for each letter it contains, that is, i times in all; and obviously the only other combinations that appear in the second member of the equation are those of the form $a^r bcd \ldots\ldots$; but since the term $a^r bcd \ldots\ldots$ appears once in $s_{i-r}\sigma_r$ and once in $s_{i-(r-1)}\sigma_{r-1}$ and nowhere else, all such terms cancel each other: which proves the equation.

CHEMISTRY.

On White Phosphorus, by Ira Remsen.

[Abstract of a paper read at the University Scientific Association, November 1, 1882].

In some experiments which the author with Mr. E. H. Keiser has been conducting for some time past on the action of phosphorus on moist air, it became necessary to prepare pure phosphorus. For this purpose ordinary phosphorus was distilled in an atmosphere of pure hydrogen and the vapor condensed by being brought in contact with cold water. Under these circumstances, it is deposited in the form of a snow-white, light, plastic mass which differs markedly in appearance and general physical properties from ordinary phosphorus. When this white phosphorus is placed on a piece of bibulous paper and the moisture thus absorbed from it, the mass melts and is transformed into ordinary phosphorus without taking fire. The same transformation takes place when the white material is heated in water to the melting point of ordinary phosphorus. Mr. Keiser will continue the experiments for the purpose of showing, if possible, what relation exists between ordinary phosphorus and the white variety. It may be that this relation is of the same kind, as that which exists between "flowers of sulphur" and "roll brimstone," though the differences in the properties are much more marked in the former than in the latter case.

BIOLOGY.

Observations on the Mean Pressure and the Characters of the Pulse Wave in the Coronary Arteries of the Heart, by H. Newell Martin and W. T. Sedgwick.

[Abstract of a paper (with 3 plates) in the Studies from the Biological Laboratory, Vol. II, No. 3; reprinted from the Journal of Physiology].

The object of the authors was by a critical experiment to endeavor to settle the long disputed point whether the aortic semilunar valves close the mouths of the coronary arteries during the systole of the left ventricle of the heart. If the valves act in this way the pulse wave in the coronary arteries of the heart must differ essentially both in form and in the period of its maximum intensity from the corresponding wave in the carotid artery. Simultaneous tracings taken in a branch of the left coronary artery and in a carotid artery agree in every respect. Hence the Thebesius-Brücke doctrine as to the closure of the orifices of the coronary arteries during ventricular systole, and as to the resulting "Selbst-steuererung" of the heart must be definitely abandoned.

The Influence of Digitaline on the Work done by the Heart of the Slider Terrapin. (*Pseudemys rugosa.* Shaw), by H. H. Donaldson and Mactier Warfield.

[Abstract of a paper in the Studies from the Biological Laboratory, Vol. II, No. 3].

These experiments were undertaken as a preliminary to investigations as to the action of this drug upon the heart of the Mammal. The results of previous observers were so contradictory and open to so many objections that a fresh study of the action of the drug upon the hearts of cold blooded animals seemed desirable before proceeding to work with the hearts of dogs or rabbits.

The chief results are: (1). When the heart is doing normal work digitaline decreases that work. (2). There is a rough relationship between the size of the dose and the extent of the decrease. (3). With small doses of digitaline the pulse rate is at first increased. (4). The diminution in the heart's work is much more dependent on the strength of the dose at any given time than on the total amount of the drug administered. A large amount given in several hours has much less effect than a smaller amount given in a few minutes. Therefore the theory that digitaline has a cumulative action lacks experimental confirmation.

On a New Form of Pilidium, by E. B. Wilson.

[Abstract of a paper (with 1 plate) in the Studies from the Biological Laboratory, Vol. II, No. 5].

The specimens on which this paper is based were obtained at the Marine Laboratory of the University in the summer of 1880. Though clearly belonging to the *Pilidium* group, they were very unlike any hitherto described species. Rabl has in a well known theory ascribed the radiate structure of many adult animals to rotatory movements of the embryo. Dr. Wilson's specimens shew that this is not a tenable doctrine, as the larvæ observed while exhibiting marked rotatory movements gave rise to bilateral adults.

On the Polar Effects upon Nerves of Weak Induction Currents, by Henry Sewall.

[Abstract of a paper in the Studies from the Biological Laboratory, Vol. II, No. 3].

The paper deals with the influence of very weak induction currents passing between one pair of electrodes on the irritability of the nerve, as shown by variations in the extent of submaximal muscular contractions, due to stimulation by another pair of electrodes. The results cannot well be summarized; they prove that marked polar (analectrotonic and kathelectrotonic) effects can be produced by induction currents.

Researches on the Growth of Starch Grains, by A. F. W. SCHIMPER.

[Abstract of a paper (with 1 plate) in the Studies from the Biological Laboratory, Vol. II, No. 3].

These researches, (which are translated from the *Botanische Zeitung*, 1881, Nos. 12, 13, 14), were carried on in the Biological Laboratory of the Johns Hopkins University. They prove that the phenomena of growth in starch granules, observed by Naegeli and on which he based his well known doctrine of growth by intussusception, can all be better explained in another manner; and bring forward new arguments supporting the doctrine of growth by surface deposition. They consequently tend to modify essentially the doctrine at present prevailing as to the mode of growth of vegetable cell walls.

Some Observations upon the Form of the Pulse Wave and the Mean Arterial Pressure in a Dog with Patent *Ductus Arteriosus*, by W. H. HOWELL and F. DONALDSON, JR.

[Abstract of a paper in the Studies from the Biological Laboratory, Vol. II, No. 3].

These observations were made on a dog about to be killed when it was noticed that its cardiac action was abnormal. Professor Frank Donaldson, of the University of Maryland, examined the animal and found the pulse rate greater and the cardiac impulse more marked than in normal dogs; also, the apex of the heart extended much farther to the left, showing marked hypertrophy. Over the whole cardiac region he observed a loud rasping cardiac murmur with the maximum of intensity over the base; also a slight murmur with the second round. Subsequent experiments made on the dog showed a normal arterial pressure, and no abnormality in sphygmo-graphic tracings, except an unusually marked dicrotism.

Professor McLane Tiffany, of the University of Maryland, made the post-mortem on the animal, and found that the *ductus arteriosus* had remained open; its calibre being at least equal to that of either pulmonary artery.

It is a fact of much interest that with such free communication between aortic and pulmonary circulations so good an average arterial pressure (as measured in the femoral artery) was maintained. It can only be explained by assuming (1) a compensatory increase in the force of the heart-beat; (2) an increase in the resistance of the pulmonary circuit; or (3) an increase in the total bulk of blood in the body. Whichever of these agencies was the effective one, the case is one of great interest, as indicating the power of the animal body to adapt itself to unusual conditions of life. So far as the authors could discover only one similar case was previously on record.

On Variations of Reflex-excitability in the Frog, Induced by Changes of Temperature, by W. T. SEDGWICK.

[Abstract of a paper in the Studies from the Biological Laboratory, Vol. II, No. 3].

In this paper, the author points out that the work of previous experimenters which seemed to shew that indirect heating of the frog's heart diminished its functional activity involves essential errors, inasmuch as the nutrition of the heart by a flow of blood through it was not properly taken into account. He also proves that the corollary from the work of the above experimenters, viz: that indirect heating of the spinal cord, (within the limits of its physiological working), might diminish its functional activity has no sound experimental basis; and he shows that much more regard must be paid as to the influence of temperature and of drying of the skin upon the reflexes of the frog, than has been paid hitherto, if any satisfactory conclusions are to be reached.

On the Influence of Variations of Intracardiac Pressure upon the Inhibitory Action of the Vagus Nerve, by HENRY SEWALL and FRANK DONALDSON, JR.

[Abstract of a paper in the Journal of Physiology, Vol. III, pp. 357-368].

Working on the hearts of frogs and terrapins the authors find (1) when the whole heart is employed, increases of venous pressure, arterial being constant, weaken the cardio-inhibitory action of the vagus. Thus confirming the results of Ludwig and Luchsinger.

2. Variations of intraventricular systolic pressure within wide limits have no perceptible effect on the vagus activity.

3. Variation of diastolic intraventricular pressure when uncomplicated by simultaneous variation in auricular pressure has no effect.

They therefore conclude that changes of intracardiac pressure when experienced by the ventricle alone are without effect on the cardio-inhibitory function of the vagus.

4. Variations of pressure within sinus and auricles, the ventricle being entirely separated from them, give the same results as when venous pressure is varied in the complete heart.

5. The effect of variations of pressure within the venous sinus, all the rest of the heart being excluded, is such that raised pressure diminishes the cardio-inhibitory action.

The paper concludes with some general considerations on the manner according to which the vagus exerts its inhibitory action upon the heart.

A Discussion of Recent Researches in Europe on the Lower Organisms and their connection with Infectious Diseases, by W. T. COUNCILMAN.

[Abstract of a paper read at the University Scientific Association, November 1, 1882].

We assume that the infectious diseases are caused by the entry of a *materies morbi* into the organism. That this *materies morbi* is a living organism in every case, appears to be proven by experiments which show that it is a substance which is insoluble and capable of increase. We know that it is a substance because it clings to inert objects and can thus be transported from one place to another or kept any length of time without losing its power; a blanket from a small-pox patient, for example, can be transported thousands of miles and then produce the disease. Chaveau's experiments with vaccine lymph and the experiments which Davaine made with the blood of splenic fever show that it is insoluble. Of all soluble poisons we know that their virulence decreases in a regular ratio with their dilutions, on the other hand no amount of dilutions, seems to take away entirely the infectious properties of the blood of animals affected with splenic fever; Davaine having succeeded in producing the disease after the blood was diluted 1,000,000 times. The disease when produced by such diluted virus differs not at all from that produced from the undiluted virus. That it has the power of increasing is shown from the fact that having introduced one of the spores of the *Bacillus anthracis* into the circulation of a mouse, in a few hours, the whole vascular system will be filled with the bacilli. Now having an insoluble substance with this power of increasing, of growing, it must be a living organism; it is possible for a soluble substance in a purely chemical manner to produce its like, to increase, but if a granule multiplies indefinitely it must divide and the divided pieces must grow. In quite a number of the infectious diseases we find either in the blood or in the pathological lesions a certain organism, and know that on inoculating animals with the tissues containing these organisms an identical disease will be produced. In order to prove that it is the organisms alone that are infectious it is necessary to isolate them completely from the tissues or fluids with which they are associated, and produce the disease by inoculation of the organisms alone. This can be done by the so-called pure culture, by growing the organisms outside of the body and transferring them from one nutrient substance to another until we know that we have them perfectly pure. In the case of splenic fever, tuberculosis, and some other diseases this has been done, while in other diseases, although we always find a certain definite organism associated with the disease, the strict objective proof that the organism is the cause of the disease is wanting because we are not able to produce the disease on the lower animals by innoculation of the isolated organisms, nor indeed in any other way. Animals show a perfect immunity to a number of our diseases. The benefits which we have derived both in prophylaxis and therapeutics, from these additions to our knowledge are great and are daily increasing.

PHILOLOGY.

A Search for Functional or Dialectic Differences in the Present Systems of the Veda, by M. Bloomfield.

[Abstract of a paper read at the University Philological Association, November 3, 1882].

The discussion began with pointing out the importance both to Sanskrit grammar and to general Indo-European grammar, of the question whether there are to be discovered in the earliest Veda any traces of a difference of use, functional or dialectic, among the present-stems—often two or three, and sometimes numerous—found to occur there from the same root. Some leading facts in the case were reviewed: the (including intensives) dozen or more present-stems of the root *tar* (*tar—tir—tur*); the six from *pi—pyā;* the five from *iṣ*, *hū* and others. A part of these formations are evident results of transition from one system to another, brought about by some form or forms derivable from more than one stem. In other cases an isolated present-form is due to the influence of a similar formation from some other root occurring along with it. Yet it must be granted that, in all the languages of the family the same root not infrequently makes present-stems with different formative elements. We might naturally look to find the cause of this either: 1, in an original functional difference of the various formations—a variety of temporal or modal use; of causal, factitive, continuative, intransitive use, or the like; or 2, in the dialectic or stylistic habit of different localities or literary compositions.

The results of the investigation, though negative in the main, offer several interesting facts. The root *bhar* shows a distinct and almost unique functional difference between its two stems *bhára–* and *bibhar–*: the former being in the terminology of Slavic grammar "perfective," regularly followed by the dative and best rendered by 'convey;' while the "imperfective" *bibhar–* is used without the dative and means 'support.' Typical examples are *bhára gṛṇaté vásūni*, "bring good things to the singer," (RV., IX, 69, 10); and *bibhárṣi vásu hástayos*, "thou bearest wealth in thy hands," (RV., I, 55, 8). But all other reduplicated presents were looked through and compared with other present-systems without any positive results.

In one present-stem from the root *tar*, namely *túrva–*, there is to be noted an occasional causative value: *e.g.*, RV., VI, 50, 10. The same causative force is very apparent in *júrva–*, and *dhúrva* may also be causative. A like tendency seems to be observable in stems of the type *jínva–*. This stem, as well as the more original *jínu–*, is readily explainable as causative of 1 *ji*, and signifying "cause to prosper." The stem *ínva–* has a like causal force, and examples of the more primitive *ínu* are used in the same manner. Less convincing is the same tendency in the stems *pínva*, *ṛṇvá*, *hínva*. Further also the stems *dhinu*, *sunu–* and *mṛṇa* can be offered as examples for causative value, while the remaining *nu*-presents yielded no such result.

In the *ya*-class (or *dīv*-class) is seen a marked tendency toward intransitive, reflexive, or even passive function; on the other hand the *ch*-class yielded no results, which could be formulated satisfactorily. In the remaining conjugation-classes also enough material was collected and examined to put beyond question the fact that there is nowhere any specialization of the use of a class, in any way that should help us to a conception of the original value of its class-sign.

A search for traces of dialectic use was also undertaken and carried far enough to show that it would doubtless continue to be fruitless, so far as the present-stems are concerned. A number of prominent roots were made the basis of the investigation, and their present-stems numbered as found distributed among the books of the Rig-Veda, in order to see whether a given book employed a given stem, or more than one, with such predilection that it might be presumed due to dialectic tendencies. But absolutely no such tendencies came to light.

On Mr. Matthew Arnold's Poetry Test, by W. J. Alexander.

[Abstract of a paper read at the University Philological Association, November 3, 1882].

This was a defence against recent criticism of the practical test for poetry, put forward by Mr. Arnold in his Introduction to "Ward's English Poets" (pp. xxv and cf.). The defence was based on an examination of the foundation and method of literary judgments in general. Attention was then drawn to the conditions and limitations which Mr. Arnold imposes upon his test, and thus it was shown that his method is precisely analogous to the more general one already investigated. The two methods were found to differ from one another only in the breadth or narrowness of the basis on which they rest, and Mr. Arnold's advocacy of the narrower was justified by a consideration of the circumstances of the Introduction. Finally, some peculiarities of Mr. Arnold's style were pointed out, and were held accountable for a considerable part of the hostile criticism which his test had invoked.

On the use of ὅτι (or ὡς) in Direct Quotations, by E. H. Spieker.

[Abstract of a paper read at the University Philological Association, November 3, 1882].

In this paper only such cases were considered as show some form of the 1st or 2nd person and are thus clearly direct quotations, cases of change of construction from indirect to direct were not treated, as the feeling is not the same. The use first appears in Herodotus (II. 115). Of the orators, (except Hyperides) Antiphon, Isaeus, and Lycurgus have no examples, the others vary between one and four, except Demosthenes, who uses it more frequently than all the others combined, most of the cases occurring in the public speeches. Thucydides uses it a few times, and Plato and Xenophon quite often. Two evident cases of ὡς introducing direct quotations were noticed in Dinarchus, viz, I. 12. and I. 102. Of this use Kühner says: '(selten ὡς),' giving no examples, while Krüger simply adds after ὅτι: '(nie ὡς).' To these examples from Dinarchus may be added Dem., XII. 151. In later Greek we find ὡς so used in Plut. Them., c. ii; possibly it occurs there oftener, but it is a rare use at best. The usual form with ὅτι also appears later, *e. g.*, New Testament: Mark, 5. 35; Luke; 8. 49, &c.

HISTORICAL AND POLITICAL SCIENCE.

Introduction to American Institutional History, by Edward A. Freeman. (A special contribution growing out of his recent lectures in Baltimore).

[Abstract of an article read in the Historical Seminary, October 6, 1882, and printed in the first number of the "Studies in Historical and Political Science."]

The institutions of Massachusetts or Maryland, such at least among them as have been handed down from the foundation of those colonies, are not simply the institutions of Massachusetts and Maryland. They are part of the general institutions of the English people, as those are again part of the general institutions of the whole Aryan family. The history of a Massachusetts township or a Maryland manor becomes, if looked at in a scientific spirit, part of the general history of the world. The scientific view of such matters consists mainly in dealing with them by the comparative method. We do not rightly understand the history of our people on either side of Ocean, unless we take in the close analogy between the English settlements in Britain in the fifth and sixth centuries, and the English settlements in America in the seventeenth century. The likeness comes out most strongly if we contrast either with the Norman Conquest in England or with the Spanish Conquests in America. These again differ greatly from one another; but they agree in the comparatively short time in which the work was done. In both of them settlement took the form of conquest, and of conquest on a great scale. But those who came in the three keels of Hengest and those who came in the Mayflower were both of them in a different position. They settled in small communities and won the land bit by bit. They brought with them the institutions of their elder country; they planted them afresh, and what they planted grew up with such changes as were wrought by the nature of the new soil in which it was planted. The most notable thing of all, yet surely the most natural thing of all, is that the New England settlers of the seventeenth century largely reproduced English institutions in an older shape than they bore in the England of the seventeenth century. They gave a new life to many things which in their older home had well nigh died out. They reproduced in many points the state of things in old Greece and in mediaeval Switzerland. A New England town-meeting is essentially the same thing as the Homeric ἀγορή, the Athenian ἐκκλησία, the Roman *comitia*, the Swiss *Landesgemeinde*, the English folk-moot. The circumstances of New England called the primitive assembly again into being when in the older England it was well nigh forgotten. What in Switzerland is a *sur*vival was in New England rather a *re*vival.

I noticed in Virginia, the only one of the Southern States of which I have seen anything, that I heard the word *county* at least a hundred times for once that I heard it in New England. The merest glance at the two countries shows that, setting aside the results of late events, the whole political organization of the two countries is different. Both have reproduced English institutions; but they have not reproduced the same English institutions. I suppose that Virginia and New England must be the most strictly English parts of the United States; the mixture of any foreign element in the original settlement must have been very small in either. But the two lands represent two different sides of England. Virginia more nearly reproduced the England of the time of the settlement. New England more nearly reproduced the England of an earlier time.

The Past and the Present of Political Economy, by R. T. Ely.

[Abstract of principal paper read before the Historical and Political Science Association, October 20, 1882].

In 1876, the centennial of Adam Smith's "Wealth of Nations" was celebrated. This event, though noteworthy for the reason that at that time the "Wealth of Nations" was the only book which had ever been thus honored, has a greater significance than could be attached to a merely formal commemoration. It marked an era in the development of social and economic science. On that occasion were elicited expressions of dissatisfaction with the methods and dogmas of the Manchester men, and there was also disclosed, more prominently than hitherto in England, the existence of a new and rising school of Political Economy, directly opposed upon points of both theory and practice to the orthodox English system. Side by side with the declaration of an ardent disciple, that Adam Smith had securely established a "deductive and demonstrative science of human actions and conduct," came the announcement of a distinguished Belgian professor, that a more advanced method of investigating economic problems had already been instituted, whose groundworks were history and statistics.

The Political Economy of Malthus, Ricardo, and James Mill, all of whom were extreme followers of Adam Smith, was almost universally received as the only true doctrine, until some thirty years ago. The teachings of these men were comparatively simple, and consisted of a few leading principles drawn from *à priori* hypotheses. Their leading assumptions were the universal selfishness of man, and his love of ease. They further assumed that wages and profits were equal, and advocated a let alone policy for all governments, in relation to questions of a social and economic nature. According to their view, Political Economy was a comparatively simple study. It was only necessary to keep in mind a few general laws and then all economic phenomena could be easily classified and fully understood. Legislators too were furnished with an infallible guide of conduct in the tenet of "*laissez-faire, laissez passer.*" It was not necessary for government to interfere in behalf of the lower classes, as Nature provided abundantly for them. The capital of the country was equitably distributed, the wage-fund going to the laborer and the profits to the capitalist. The possible existence of an unfair distribution of wealth was ignored. Some economists went so far as to speak of a "so-called poor man." Every thing was as it should be, and the highest good of society was best promoted by the individual, self-interested action of each member.

A merit of this system was, that it separated wealth from other social phenomena for separate study. It showed the impossibility of understanding society without investigating the process of the production and distribution of economic goods. It served an important purpose in pulling down old and worn-out institutions, which, by prolonged retention, had become barriers to progress. According to the acknowledgment of Baron vom Stein, the "Wealth of Nations" furnished him with the basis of the sweeping and beneficial reforms which he inaugurated in Prussia. It was instrumental in introducing international free trade in England. It did a good work, but its action was purely a negative one. It served a similar purpose to the French Revolution, being powerful to pull down but powerless to reconstruct. It answered satisfactorily the needs of the latter part of the eighteenth and the earlier part of the nineteenth centuries.

Its leading assumptions were, however, largely false. No man is entirely selfish. This is proved by numerous facts of every-day life as, *e. g.*, that during the late "hard times" many manufacturers continued their business primarily, for the sake of affording employment to workmen who who would otherwise have been sorely distressed. While competition has a powerful influence in regulating wages, it does not, even in the majority of cases, reduce them to the lowest possible limit. This is shown upon competent statistical authority. In regard to selfishness being the motive power of the masses, national honor, devotion to principle and the altruistic sentiment of wishing to benefit one's kind are strongly counteracting influences. The doctrine of the equality of wages and profits does not stand the test of experience. Neither are taxes so shifted as to be divided fairly between different employments. A non-intervention state policy has proved a complete failure. It has not been carried out even in England. The circumstances which compelled the passage of the Factory Act, the regulations regarding the employment of labor, the reforms in the Irish land laws and the introduction of a system of compulsory education, show how entirely foreign to the spirit of true progress is the tenet of "*laissez-faire.*"

The Political Economy of the Manchester school was attacked by Müller, Sismondi, List, Carey, and others; but no successful attempt was made to establish a new system until about 1850. At that time the writings of Hildebrand, Kneis, and Roscher, three young German professors, began to attract attention. They inaugurated a new method of investigating economic problems somewhat analogous to that used in the various departments of Physical Science. In their view the history of the world had been a series of great economic experiments. They held that these should be studied in connection with accurate statistical data from the present. The results could then be generalized into laws, not final and unvarying for all countries and all times, but which must be continually modified by experiences gathered from fresh statistics. Hence the new school of Political Economy has been called the Historical—also Experimental, Statistical, and Comparative. Political Economy is regarded by the adherents of this method as only one branch of social science, viz., that which deals with social phenomena from an economic standpoint. They view it in the light of a growth, a development, and much significance is attached to time and historical environment. They do not assume that there is one universal economic policy for all countries, but rather that there is a national economy applicable to each. This school insists strongly upon the moral basis of Political Economy, and regards man and not wealth as the factor of leading importance to be considered. It aims continually at the elevation of mankind, and especially of the lower classes. It gives unceasing attention to the problem of the equitable distribution of economic goods, watches the increasing power of large corporations and wealthy monopolists, and counsels the fostering care of governments, when their intervention is needed, to protect the weak or to promote the efficiency of any great engine of social progress.

This school has gained most ground in Germany, where it is now the dominant system. It has made considerable progress in other countries, and is represented in England by Cliffe-Leslie, Thorold Rogers and the late Stanley Jevons having considerable sympathy with it; in Belgium, by de Laveleye; and in Italy, by Cossa, Lampertico, and Luzzati; in America, one finds in the writings of Francis A. Walker the independence and vigor characteristic of this school. It indicates the tendency of modern thought upon social and economic questions.

Political Economy in Germany in 1882, by R. T. Ely.

[Abstract of principal paper read before the Historical and Political Science Association, November 17, 1882].

The three most prominent events in the history of Political Economy in Germany during the present year have been the appearance of a new and complete text-book of the science, edited by Prof. Schönberg, of the University of Tübingen, the meeting of the Economic Congress (der volkswirthschaftliche Congress) in September, and the assembly of the Union for Social Politics (der Verein für Socialpolitik) in Frankfort-on-the-Main in October.

The Economic Congress was founded in 1858 by Prince-Smith, an Englishman by birth, Faucher, Victor Böhmert, Max Wirth, and Michaelis. Followers of Adam Smith, as developed and interpreted by Bastiat, they opposed all interference of government in economic affairs, holding with the latter that "the action of government is essentially limited to the maintenance of order, security, and justice, and that all action of government beyond this limit is a usurpation upon conscience, upon intelligence, upon industry, in a word, upon human liberty." The meeting of the Congress this year was the twentieth and was attended by a considerable number of manufacturers, merchants, politicians, and editors.

Its efforts have in the past been successful in the field of legislation, because its proposed reforms answered the needs of the time. Its cry to government was, "hands off," "let the people alone," "do business the favor of getting out of its sunshine." It was a time for tearing down, and the advice was good. But when the North German Confederation was formed in 1866, the situation changed. All the most necessary negative economic reforms were effected. Not adapted for positive work, the Economic Congress began to decline in the number and importance of its members, although it has continued to hold annual meetings.

The Union for Social Politics was formed in 1872 for the purpose of combating the negative and narrow views of the Economic Congress as well as to aid in carrying out positive economic reforms. Its members are for the most part university professors of Political Economy. It has been remarkably successful in its propaganda, has been instrumental in exciting the widest interest in Political Economy throughout Germany, has converted the cultured and learned public and the better part of the press to its views, and has exerted a considerable influence on the administration and legislation of the last ten years.

The meeting of the Union in October was such as to make quite the opposite impression from that given by the assembly of the Economic Congress in September. Young, vigorous, and adapted to the times, it entered actively into the discussions of questions of the day, and was in a position to build up as well as tear down.

Schönberg's Handbook of Political Economy has been produced on the basis of coöperation, and is noteworthy as the first treatise on that subject which was ever produced by the combined labor of several authors. Twenty-one men, embracing nearly all of the ablest political economists in Germany, have united in the production of this one work. Each one has written that part for which acquirements and native ability best fitted him. The result of this liberal and enlightened policy is one of the best economic treatises—if not the best—ever written.

Plymouth Rock Restored, by H. B. Adams.

[First Part read in the Historical Seminary, November 10, and to be published in the Magazine of American History, December, 1882. Second Part, in the same Magazine, January, 1883].

The restoration of Plymouth Rock, by Mr. J. Henry Stickney, of Baltimore, to its original place by the sea-shore, whence it was dragged by twenty yoke of oxen and the revolutionary patriotism of 1775, for the support of an American liberty-pole in the Town Square, suggested the restoration of Plymouth Rock to its historic connections with other Pilgrim landing-places, namely, Clark's Island, and various points along Cape Cod, over which the Pilgrim Fathers ranged for an entire month before landing at Plymouth. The relation of Plymouth Rock to Provincetown is not generally understood. Students are beginning to regard Germany, England, and New England, as historic stepping stones for the Aryan race in its colonial progress westward. The colony at Plymouth was but one step in English migration. Perhaps too much stress has been laid upon the settlement of New England, and too little upon kindred settlements elsewhere. It is not unlikely that Forefathers' Day has been hallowed to a degree unwarranted by the simple facts relating to the 21st of December. There was no landing upon Plymouth Rock from the Mayflower on that day, for the Mayflower lay anchored in Cape Cod Harbor, more than twenty miles distant. At most, the landing was by a party of explorers, who had gone ashore at the land's end of Cape Cod as early as the 21st of November, who had traversed the Cape for many miles in three successive expeditions, and who, after landing at Plymouth on the 21st of December, returned to Cape Cod. There never was any general disembarkation of the Pilgrims upon Plymouth Rock at any one time. Certain passengers, including probably women, children, and sick people, stayed on board the Mayflower all winter. There is abundant evidence that there was a constant going to and fro between ship and shore until the 31st of March, 1621, "a fine warme day," when the shallop was sent "to fetch all from aboord." The above articles will review some of these points, not for the purpose of undermining Plymouth Rock, but for the sake of restoring it to a basis of fact. It is not impro able that the Rock was long used for a landing-place, for to this day t venerable boulder, itself a Pilgrim upon that low-lying sandy coast, li embedded in a wharf, which Mr. Stickney proposes to remove. Th gentleman has not only restored the Rock, but he has renovated Pilgri Hall and made it fire-proof. He has generously purchased land for t sake of restoring to its original proportions Cole's Hill, the first bur ing ground of the Pilgrim Fathers. Mr. Stickney has already expend nearly twenty-five thousand dollars upon historic restorations at Plymou and he hopes to continue the work.

Local Government in the Northwest, by E. W. Bemis.

[Abstract of a paper read in the Historical Seminary, October 13, 1882, and bef the American Social Science Association, Saratoga, September 7, 1882, to be published its annual Proceedings. Cf. "Local Government in Michigan," University Circula April, 1881].

The Northwest territory (now divided into the States of Ohio, Indian Illinois, Michigan, and Wisconsin) may be profitably studied as a lar area where the two systems of centralized and decentralized power hav been brought together. The political development of this territory beg after the evacuation by the British. Michigan, which first adopted t town-meeting, is worthy of special study. We notice, throughout i history, a State founded not like Massachusetts, with the greatest sel government from the beginning, but with the despotic system of Franc and gradually gaining political liberty. The change even from the co stitution of 1835 to that of 1850, is particularly striking. Michigan w the first State of the West to adopt the town-meeting. She has been fo lowed in this by Wisconsin, Minnesota, and Illinois. Ohio, Indiana, an Illinois were settled more largely by people from Pennsylvania, Virgini and Kentucky, and naturally they have adopted a compromise syste similar in many respects to Pennsylvania. Ohio and Indiana have town ship officers elected by the people, but few questions of a legislative c administrative character are submitted to the voters. In Illinois, how ever, in 1848, a law was passed by which on a vote of the electors of county it might adopt township organizations with power lodged in t town-meeting as in Michigan and Wisconsin. Seventy-five of the o hundred and two counties have already so voted, seven since 1870.

A town-meeting in Michigan is thus conducted: On the first Monda in April every male citizen who has resided in the State six months an in the township the ten days preceding has the right of local suffrag The supervisor, the executive officer of the township, presides, and he an the justice of the peace whose term of office soonest expires and the town ship clerk constitute the inspectors of election. The electors may regulat the keeping and sale of gunpowder, the licensing of dogs and the mai tenance of hospitals, and may order inoculation of all in the townshi and raise money for sustaining any suits in which the town may becom engaged, as also for roads and bridges, the poor and other townshi expenses. The voters in town-meeting are also to decide how much the proceeds of the one mill tax on every dollar of the valuation shall b applied for the purchase of books for the township library, the remainde going to schools. The annual reports of the various township office charged with the disbursement of money are also given at this time. I short whatever concerns the township only is in the control of the peopl Yet there are some minor differences from the New England town-mee ing. In Michigan, the by-laws and regulations are less varied in cha acter, because that part of the township where the inhabitants are mo numerous, and for whose regulation many laws are necessary, is set off an incorporated village, as in the central States, with provision for ma aging in large measure their own affairs, though in most States subject t the township in some things. Similar powers are lodged in the tow meetings of Wisconsin, Minnesota, and Illinois. Minnesota as a territor had the county system, there being no incorporated townships. O becoming a State in 1858, the Illinois system was adopted bodily, change again at the end of two years for the county system, but townships we soon restored.

The District System of South Carolina, by B. J. Ramage.

[Read in the Historical Seminary, November 3, 1882].

South Carolina is one of those States in which there has been a struggl between two ideas of local government. The Parish as a political divisio of the State existed only along the coast. The "up country" was settled by Virginians and Pennsylvanians, who brought with them their own ideas of local government—the county. There was no bond of sympathy between the two colonies in the State, *i. e.* the English colony on the coast and the American pioneers of the interior. The English colony ruled both in Church and State. But the "up country" was soon organized into Judicial Districts. These Districts afterwards passed into political units, and corresponded to the county of Virginia and Pennsylvania. It was largely through the influence of the Virginia settlers that the "up country" was organized, and the influence of Pennsylvania is seen in the names of the Districts of York, Lancaster, Chester and others. Each District had charge of its own poor, schools, roads, bridges, etc. The District slowly won its way over the parish, but both were abolished by the Reconstruction-Constitution, and the County is the prevailing type of local government throughout the State.

PHYSICS.

On Concave Gratings for Optical Purposes, by H. A. ROWLAND.

[The following semi-official report of a meeting of the Physical Society of London, November 11, 1882, is taken from the English journals].

Professor Rowland, of Baltimore, exhibited a number of his new concave gratings for giving a diffraction spectrum. He explained the theory of their action. Gratings can be ruled on any surface of the lines, are at a proper distance apart, and of the proper form. The best surface, however, is a spherical one. The gratings are solid slabs of polished speculum metal, ruled with lines equidistant by a special machine of Professor Rowland's invention. An account of this machine will be published shortly. The number of lines per inch varied in the specimens shown from 5,000 to 43,000, but higher numbers can be engraved by the cutting diamond. One great advantage of their use is that the relative wave-lengths can be measured by the micrometer with great accuracy. The author has designed an ingenious mechanical arrangement for keeping the photographic plates in focus. In this way photographs of great distinctness can be obtained. Professor Rowland exhibited some, ten inches long, which showed the *E* line doubled, and the large *B* group very clearly. Lines are divided by this method, which have never been divided before; and the work of photographing takes a mere fraction of the time formerly required. A photographic plate, sensitive throughout its length, is got by means of a mixture of eocene, iodized collodion, and bromized collodion. Professor Rowland and Captain Abney, R. E., are at present engaged in preparing a new map of the whole spectrum, with gratings having a focus of 18 feet. In reply to Mr. Hilgar, F. R. A. S., he stated that if the metal is the true speculum metal used by Lord Rosse, it would stand the effects of climate, he thought; but if too much copper were put in it might not. In reply to Mr. Warren de la Rue, he said that 43,000 was the largest number of lines he had yet required to engrave on the metal.

Professor Guthrie read a letter from Captain Abney, pointing out that Professor Rowland's plates gave clearer spectra than any others; they were free from "ghosts," caused by periodicity in the ruling; and speculum metal had no particular absorption.

Professor Dewar, F. R. S., observed that Professor Liveing and he had been engaged for three years past in preparing a map of the ultra-violet-spectrum, which would soon be published. He considered the concave gratings to make a new departure in the subject, and that they would have greatly facilitated the preparation of his map.

The letter of Captain Abney, R. E., F. R. S., above referred to is as follows:

"Professor Rowland is going to show his gratings at the next meeting of the Physical Society which I am unfortunately prevented from attending owing to absence on duty.

"I think it well to write a line to ask you to give my experience of the gratings as I have had more opportunity of testing them than any one else in this country, owing to Professor Rowland's kindness.

"I have tested them with the sun and with the electric light, and I must say that I have never seen any diffraction as perfect as with any of them, for they seem all alike good. With a flat grating in the 3d order, I have been able to see what is a tolerably fine line in the *B* band split into two. If I may call it so, the nucleus of *B* which is usually represented as a solid black band is seen to be made up of 18 lines, two of them being the split line I referred to above.

"Another great point is the comparative total freedom from ghosts caused by periodicity in the ruling. In a grating which Professor Row- has given me, I have vainly endeavored to find a trace of one.

"Now a word about the concave gratings. They are wonderfully brilliant, the spectrum with a fine slit easily being seen on a piece of white paper in good daylight at a distance of 13 feet. I need scarcely point out the tremendous use they will be in all researches on the dark rays of the spectrum; it being possible to work without any intervening medium, and I have already proved the speculum metal has no appreciable absorption for these rays.

"If I were present I would say more, but I have said enough to show how I appreciate the new weapons of attack that Professor Rowland has given us. I believe that physicists will owe a debt of gratitude to him when those who have worked with the old gratings compare what they have done with what they can do with the new."

The Transit of Venus as Observed in Baltimore.

[The following account is taken in substance from a telegraphic report in the *New York Herald*, December 7, 1882].

Dr. Charles S. Hastings, associate professor in physics at the Johns Hopkins University, and Dr. J. R. Hooper, made observations of the transit to-day from the grounds of the Johns Hopkins Hospital, on North Broadway. The telescopes were placed in small temporary structures a short distance eastward from the centre of the grounds, at a point where a clear sweep of the southern heavens could be had. Each instrument rested on a base of masonry built upon the solid earth, so as to avoid all vibration. Drs. Hastings and Hooper, with their assistants, Messrs. A. L. Kimball and D. T. Day, fellows of the University, and Mr. C. A. Perkins, a graduate student, assembled at the observatory about 8h. 30m. a. m. The sun was the greater part of the time obscured by clouds, but preparations for the observation were made, and at 8h. 56m. the calling of time was begun. The first contact was lost as, just at the moment a cloud obscured the sun's face. The results obtained by Dr. Hastings were as follows:—*

	h.	*m.*	*s.*
Second contact "not yet"	9	16	27
Actual contact	9	16	34
Well passed	9	16	46
Third contact "not yet"	2	39	44
Actual contact	2	39	53
Well passed	2	40	14
Fourth contact "not yet"	3	00	15
Actual contact	3	00	30

Dr. Hooper's figures varied but very little from those of Dr. Hastings. The uncertainty of interior contacts was not more than one and a half seconds. Between the first and second contacts and the third and fourth a ring of light was observed around Venus, which grew brighter and developed into a brilliant band. This, as is well known, proves that Venus has an atmosphere which possesses the power of refracting the sun's rays. Professor Hastings is very much pleased with his observations, which were made in the presence of the President, the Faculty, and many of the Trustees of the University.

The International Commission of Electricians.

Professor Rowland of this University, and Professor Trowbridge, of Harvard University, have returned from the meeting of the Electricians in Paris, to which they were sent by the United States Government in October last.

The Conference failed to reach any important conclusion in respect to the value of the Ohm, but it urged further preliminary investigations, called attention to the methods which appear to be most promising, and advised that governmental aid should be sought in the prosecution of the inquiry.

The Conference adjourned to October 1, 1883.

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* Washington Mean Time. The figures here given have been corrected for error of chronometer.

JOHNS HOPKINS UNIVERSITY STUDIES IN HISTORICAL AND POLITICAL SCIENCE.

[*Preface by* DR. H. B. ADAMS, *Editor of the Series, to* MR. E. A. FREEMAN'S "*Introduction to American Institutional History*"—*part I of the Studies in Historical and Political Science*].

MR. FREEMAN'S VISIT TO BALTIMORE.

Mr. Freeman came to America in the fall of 1881, on the joint invitation of the Lowell Institute in Boston and of the Peabody Institute in Baltimore. The united influence of these two local institutions, representing the intellectual union of Northern and Southern cities, was seconded by two other influences of a local character: first, by Mr. Freeman's natural desire to visit his own son, who married in Baltimore and who now lives upon a plantation in Virginia; secondly, by an ardent longing to see with his own eyes a New England Town Meeting, which, in the genealogy of local institutions, is a long-lost child of Old England and a grandchild of the Fatherland. The historian of "The English People in their Three Homes" regards the local institutions of the United States, North and South, as the historic offspring of England and Germany, as truly as his own name, once applied to all freemen of the English Colonies in America, is directly perpetuated by children and grandchildren in the Old Dominion, where he indulged what he pleasantly calls "oldfatherly emotions towards the last born *bairn's bairn*," and where, true to historical impulses, he began a "Virginia Domesday" in the old forms: "*Freeman tenet; Bell tenuit Ante Guerram. Valebat . . . dollarios; modo . . . Waste fuit.*" With the grim humor of William the Conqueror, who, when he fell to the earth upon landing at Pevensey, grasped the soil and thus took seizin of England, Mr. Freeman describes his son's territorial conquest upon the shore of the Rapidan, "*Potuit ire quo voluit cum ista terra*, for the soil of the Old Dominion sticketh to the boots and is carried about hither and thither!"

This extract from a letter dated Somerleaze, Rapid Ann Depot, Culpeper County, Virginia, December 25th, 1881, needs no better commentary than the following extract from the *Inquisitio Eliensis*, Domesday, iii, 497 (or Stubbs' Select Charters, 86): "*Deinde quomodo vocatur mansio, quis tenuit eam tempore Regis Eadwardi; quis modo tenet; . . . quantum valebat totum simul; et quantum modo; . . .*" The suggestion of Domesday-forms came to Mr. Freeman not only from the history of Virginia land-tenure, but from Professor William F. Allen's paper on "The English Cottagers of the Middle Ages," a paper which had been sent Mr. Freeman in answer to his query "about a man in Wisconsin, who has written something about villainage—what a long way off to know about such things—how can I get it?" And after receiving the above paper, Mr. Freeman inquired with manifest surprise, "Are his cottagers the *cotarii* of Domesday?" The historian of the Norman Conquest was reminded of items in Domesday by the "*Afri*" of the South, who still survive in emancipated forms. The negroes of the Old Dominion are no longer "*servi*," but their varying economic condition might justify their enumeration in some such classes as appear in the Norman census: "*villani*," "*cotarii*," "*sochemani*," "*liberi homines*."

It brings the historian of "The English People in their Three Homes" to the very heart of both North and South to think of him as spending Christmas with his American children upon a Virginia Plantation, called after the Old Home in England, "Somerleaze," where, resting from lectures and labors, he indulges "oldfatherly emotions" towards his American grandchild. It is pleasant to think of the Nestor historian "among the hills, enjoying the air, with the Blue Ridge right in front," and reading a novel about the Old Dominion written by a Virginia lady now living in Baltimore. He writes to this city for information touching the plot of the historical novel. "Was there not a negro revolt once hereabouts called Gabriel's War? I was reading a pretty story called *Homoselle*, where it comes in, and I seem to have heard of it before; but nobody here can tell me. If the chronology of the story be right, it must have been between 1837 and 1861." And later he returns to the point: "I knew I had heard something of that Gabriel's War, but Mrs. Tiernan must have altered the date. You say it was early in this century; but *Homoselle* lies in the time 1837-1861. For, on the one hand, Victoria reigns in Great Britain; on the other, Peace and Slavery reign in Virginia.[*] I want to know another thing. *Homoselle* speaks of a free negro in Virginia. Another story speaks of free negroes as forbidden to dwell there. Some of your students of State laws will know the date of that bit of legislation."[†]

Mr. Freeman's visit to Baltimore occurred before his visit to Virginia. He lectured first in Boston, then at Cornell University, and immediately afterwards in Baltimore at the Peabody Institute, beginning November 15 and continuing until November 25. Both Cornell and Johns Hopkins Universities availed themselves of Mr. Freeman's visit to America to engage him for short courses of lectures before their students. On arriving in Baltimore, the first place Mr. Freeman visited was the University-Library. Although the historian professes "to hate libraries as well as schools," his professions should not be taken quite literally. He evidently enjoyed what some people call the "Johns Hopkins *School*," and he stayed one entire forenoon, and came again the next day. He found some things that he had never before seen, and he manifested considerable interest in the so-called "New Book Department"—an arrangement for securing the most recent scientific literature from England, France, and Germany. Mr. Freeman saw at once the cosmopolitan relations and practical value of this department and also of the University system of "exchanges" with the proceedings of academies and other learned societies of the old world. He even intimated that his own retired life at his country-home in Somerset cut him off in some degree from the main stream of contemporary literature, to which members of the Johns Hopkins have constant access. This frank confession is not at all inconsistent with Mr. Freeman's well-known answer to the American professor who asked him where he wrote his books: "In my own house, to be sure, where else should I?" Although the historian of the Norman Conquest declares that he has never in his life consulted the library of the British Museum, yet he himself admits that, "There are times for which the library of the British Museum, or any other public library must be invaluable; but these times are not the eleventh and twelfth centuries." The point is, that for a man's own *special* study, it is possible to have, in some cases, all necessary original materials around him. That point Mr. Freeman saw illustrated again and again in the special department-collections of the Johns Hopkins *Universitas Studiorum.* But it would be strange indeed if the great and rushing stream of nineteenth century literature did not impress the English historian of politics even more profoundly than it does those who are borne upon the current. He feels keenly enough "the utter hopelessness of keeping up with the ever-growing mass of German books, and yet more with the vaster mass of treatises which are hidden away in German periodicals and local transactions. Of all of these every German scholar expects us to be masters, while to most of us they are practically as inaccessible as if they were shut up in the archives of the Vatican."

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[*] Gabriel's War, a negro insurrection headed by a slave of uncommon ability, known as "General Gabriel," occurred in the year 1800. The uprising was planned with great skill and secrecy, and embraced about one thousand slaves. The plan was to make a night attack upon Richmond, massacre the male inhabitants, spoil the city, seize arms, and create a general panic among whites throughout the State, whereupon, it was thought, a general insurrection could be kindled among the slave population. On the night of the proposed attack there was a furious rain-storm; but the slaves, undaunted, advanced with their scythe-blades and axes. The attack was frustrated by two unforeseen events, the rapid rising of a creek before Richmond, and the betrayal of the plot by a faithful servant of William Mosby—a slave named Pharaoh—who swam the creek at the risk of his life and gave the alarm in Richmond. The town was at once put under arms, and the slaves, finding that their plot was discovered, rapidly dispersed. James Munroe was at that time Governor of Virginia and he offered a reward of three hundred dollars for the arrest of Gabriel, who was finally taken and executed. Many other conspirators were found out and were duly tried and convicted by the court of "Oyer and Terminer," made up of county justices. The Court Records of Henrico County contain evidence upon this matter, see Howison's History of Virginia, ii, 392-3. This insurrection naturally created the greatest horror throughout all Virginia, and the story of Gabriel's War was repeated until it became a household tale. The authoress of *Homoselle* did not need to consult the written history of Virginia for information, for the oft-told story was stamped upon every child's imagination. Mrs. Tiernan never saw Howison's account of Gabriel's War until after her story was written, the scene of which she purposely laid in later times of which she herself had personal knowledge. Without regard to the exact chronology of Gabriel's War, Mrs. Tiernan utilized a popular tradition for literary purposes, which is not only an artistic but a perfectly legitimate method in *Culturgeschichte*.—H. B. A.

[†] Free negroes were "permitted by the court of any county or corporation to remain in this State" (Code of Va., 1849, 466, Code, 1860, 520); but the *law* against emancipated negroes abiding in the State or Colony was of very ancient standing. According to the Act of 1691, no person could set free a slave, without paying for his transportation out of the country within six months after setting him free. The Act of January 25, 1806, was fundamental to all Virginia legislation during the present century touching the condition of freedmen; it was provided that if any slave thereafter emancipated should remain within the State more than twelve months after his right to freedom accrued, he should forfeit such right and might be sold for the benefit of the poor of the county or corporation. Cf. Acts 1815-16, Code 1819, Acts 1826-7, 1830-1, 1836-7. By an Act of 1840-1, "No free negro shall migrate into this State." By the Va. Const of 1851, which was in force in 1860, "Slaves hereafter emancipated shall forfeit their freedom by remaining in the commonwealth more than twelve months after they become actually free, and shall be reduced to slavery as may be prescribed by law." The letter of the law was probably more severe than the spirit of its execution. In point of fact, both free and emancipated negroes were *always* allowed in Virginia by permission of the justices of a county court. In fact, the law allowed "free negroes" to "be registered and numbered" every five years by the clerk of the county court (Codes of 1849, 1860). Free negroes were even allowed to own slaves of a certain kind, for example, a free negro could own his wife and children, and their descent, also his own parents. And conversely, a free negro wife might own her husband, children, and parents.

A student from South Carolina, Mr. B. J. Ramage, says it was no unusual thing before the war for free negroes to own considerable property, both real estate and slaves. He calls attention to an interesting item in the Baltimore *Day*, September 27, 1882: "Henry Todd, who lives in Darien, is the wealthiest colored man in Georgia. When a youth, his master died and left him his freedom. When the Confederacy fell, he lost twenty slaves and some Confederate bonds. After the war, he continued farming operations and engaged in the lumber business. He is now 65 years old and is worth $100,000 in good investments."—H. B. A.

The continuity of human history is the life principle of Mr. Freeman's philosophy. This principle he found already transplanted to American shores. He found it germinating in the Public Schools of Baltimore through the influence of his friend the Superintendent of Public Instruction, Henry E. Shepherd, formerly a student at the University of Virginia, now President of Charleston College, South Carolina. He found this principle bearing fruit in the Johns Hopkins University. The English historian became interested at once in the studies of Historical and Political Science, which were there in active progress. He met students in private and in public. He visited their special libraries and work-shops, where he lent his master-hand in aid of apprentice tasks. With Bacon's folio edition of the Laws of Maryland before him, he pointed out to Maryland young men—graduates of the Johns Hopkins University, the City College, and the Public Schools—the continuity of Old English institutions in their native State. He went with a member of the University to the Library of the Maryland Historical Society, where in the company of Mr. John H. B. Latrobe, the President, Mr. J. W. M. Lee, the Librarian, and other members of that institution, he examined some of the manuscript records of Colonial Maryland. And, before leaving Baltimore, he penned the following letter which was intended by him to quicken public as well as individual interest in the collection and publication of the Maryland State Papers:

"*Mount Vernon Hotel, Baltimore, November 27th,* 1881.

"I cannot leave Baltimore without saying a word or two about the State records of Maryland, of which you were good enough to give me a glimpse both in the University Library and in that of the Historical Society. I did not see much, but I saw enough to get some notion of their great interest and importance. But the few things which I saw either in print or in manuscript must, I fancy, be mere fragments from far greater stores at Annapolis or elsewhere. A systematic publication would be a very great gain, and the State Legislature would surely not refuse its help, if the matter were pressed upon it by influential persons and societies in the State. During the short time that I have been in America, I have been more and more impressed by the deep interest of the early history of all these lands, first as provinces, then as independent States. Each State has in the most marked way its own character, and gives some special kind of instruction in comparative political history. The local annals of Maryland or of any other State are something more than mere local history, something more than part of the history of the United States or of the whole English-speaking people. They are really contributions to the general science of politics—no less than the lessons which we should have had if Aristotle's comments on the kindred commonwealths of old Greece had been spared to us. . . . ."

This letter, shown to influential men, and read to the Historical Society by the Hon. George William Brown, in connection with a similar letter written by James Bryce, M. P., who was in Baltimore at the same time with Mr. Freeman, has at last resulted, through the combined action of the Society and of the State Legislature, in the transfer of the mass of Colonial and Revolutionary Archives from Annapolis to Baltimore, where, in a well-lighted but fire-proof vault lately constructed by private subscription, the manuscript records can be used to the best advantage by students of Maryland History. The State has also provided for the gradual but systematic publication of these Archives under the auspices of the Maryland Historical Society. Thus by the institution of an honorable Record Commission, a purely scientific undertaking is removed from all political influences. These results are the direct historic outgrowth of Mr. Freeman's letter, supported by personal and corporate power. The letter was first published in the New York *Nation,*[*] immediately afterwards in Baltimore newspapers, and a copy of it was sent to every member of the Maryland Legislature. The letter is reproduced above in a more complete form than heretofore, for the sake of its permanent preservation as a contribution to the Science of Maryland History.

Mr. Freeman's visit to Baltimore has a certain historical value, which will become more and more apparent when the influence which he exerted here upon the Historical Society and upon the Johns Hopkins University goes forth into the State of Maryland and into the country at large. The English lecturer made an impression wherever he went in this country, in Boston, Ithaca, New Haven, Providence, New York, Philadelphia, St. Louis, and other places; but it is the writer's belief, based upon careful inquiry, that the impression produced upon the students of the Johns Hopkins University, the young life of Baltimore, was the best, the strongest, and the most abiding of all. While his public lectures at the Peabody Institute and elsewhere excited much attention and remark at the time they were given, yet these popular addresses, tested by the comparative method, were everywhere less quickening and less permanent in their historic influence than the half dozen informal "talks" given to a company of advanced students, meeting in Hopkins Hall upon the afternoons of days alternating with Mr. Freeman's public lectures at the Peabody Institute. In a room of small size before a strictly University audience, without a sheet of paper between him and his hearers, with no lyceum-apparatus save a pointer and one or two outline-maps prepared for the illustration of special matters, Mr. Freeman in plain English,—vigorous, and eloquent—set forth "the Eternal Eastern Question" in the light of past Politics and present History. He spoke of the Roman Power in the East; the Saracens and the Slavs; the final Division of the East and the West; the Turks, Franks, and Venetians; the Ottomans and the Beginnings of Deliverance. Probably no such telling, inspiring course was anywhere given by the English historian in his American tour.

Circumstances contributed to make Mr. Freeman's lectures at the Johns Hopkins University a peculiar and remarkable success. In the first place, the President of the University had insisted upon it that Mr Freeman should *talk* to the students upon some special theme instead of *reading* one of his two general courses of written lectures. The informality of these "talks" which Mr. Freeman was at first very reluctant to give, was made doubly pleasing by the fact that the historian proved a good extempore speaker. The author of the Norman Conquest has "stumped" the County of Somerset and knows how to make a good off-hand speech. In the second place, the natural orator was doubtless fired by the enthusiasm of his student-hearers and by the presence and applause of another historian and politician, his friend James Bryce, M. P., whose remarkable lectures upon English Politics followed close upon Mr. Freeman, upon the same platform, and upon the same days.

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[*] Note in the *Nation*, December 22, 1881, in connection with a review of the "Calendar of Virginia State Papers;" cf. article in the Baltimore American, December 24, 1881; editorial in the Sun, December 26, 1881; New York Times, December 29, 1881. An account of the Archives themselves and of the provisions of the Bill which passed the Maryland Senate, March 16, and the House of Delegates, March 12, 1882, may be found in the *Nation* "Notes," March 30, 1882; also, in the same number, an account of the "Stevens Index of Maryland Documents in the State Paper Office, London," which Index, containing descriptions and abstracts of 1,729 Maryland documents now preserved in England, was presented to the Maryland Historical Society by George Peabody, and thus supplements the Annapolis collection. These *Nation* "Notes" of March 30, 1882, were reprinted in the Johns Hopkins University Circular, May, 1882.

But what most of all contributed to Mr. Freeman's success at the University was the unimpeded rush of his own thought and feeling into the historic fields of South-Eastern Europe, on which political interest was then centering anew.

Mr. Freeman had come to America directly from Dalmatia without tarrying in England. He had come from the historic border-ground between the Aryan and the Turk, between Venice and the Ottoman Power, between Old and New Rome. He had come to the Western Empire of the English People, which, expanding with the great Teutonic race from local centres, is repeating in the continental island of Atlantis and in the continent of Asia, with Egypt and Ocean between, the experiment of the Roman People upon a grander and nobler scale. He came from ancient municipal centres of Grecian culture and Roman dominion,—from Ragusa, upon the rocks of the Dalmatian coast, a city of refuge for the Grecian colony of Epidauros,[*] as Rome was a city of refuge for the village communities of Italy,—from Spalato in Dalmatia, once a city of refuge for a Roman Emperor, Diocletian, who, born in this Illyrian border-land, was the first to propose the institution of two Caesars and of Roman capitals wherever Emperors took up their abode, whether at Spalato, Nikomedeia, Milan, Trier, or York.

The English historian of "The Illyrian Emperors and their Land" came to a *new* York and to other capitals of a westward-moving English Empire. Like an historical ambassador from the East, such as Emanuel Chrysoloras, who came from Constantinople to Rome in 1396 in the interest of the Eastern Empire and tarried in Italy three years to teach Greek; or as Georgius Gemistus (Pletho) who came in the interest of the Greek Church to attend the Council of Florence in 1439 and remained in that city for many years to lecture upon Platonic Philosophy, even so the historian of "The English People in their Three Homes," coming to Boston and Baltimore with a message upon his lips that invited national belief in the civic kinship and religious unity of England and America, came also with another message from the East. He came representing the *history* of an older Eastern Empire than that of England in Egypt and India. He came with a book in press upon "The Subject and Neighbor Lands of Venice"[†] (Spalato, Ragusa, and other Dalmatian cities) and before that book was published in America, Mr. Freeman had told students in Baltimore the story of the Republic of Ragusa, "the one spot along that whole coast from the Croatian border to Cape Tainaros itself, which never came under the dominion either of the Venetian or of the Turk,"—that city upon the rocks which "has always sat on a little ledge of civilization . . . . with a measureless background of barbarism behind her." Before Mr. Freeman's article on "The Revolt in Dalmatia" was published in the *Nation* (February 16, 1882), the latest dispatches upon which that article was based, had been made known in Baltimore. The letters and telegrams from Ragusa to the *Manchester Guardian* by Arthur Evans,[‡] Mr. Freeman's son-in-law, were almost the only trustworthy sources of information in England regarding affairs in Dalmatia. Mr. Freeman left Ragusa in June, 1881, when, as he says in the *Nation*, "the storm was beginning." From that time on, Mr. Evans kept him informed as to the progress of the Revolution, and those manuscript letters from Ragusa were shown to students in Baltimore.

In such ways, through living, winged words, *ἔπεα πτερόεντα*, young men in America were made to realize that contemporary Politics is only History in the making. And they will use a motto from Mr. Freeman — History is past Politics and Politics present History[§] — not only upon the wall of their class-room, but upon their published "Studies in Historical and Political Science," to which the Historian of Politics kindly offers an Introduction, which he wrote after his return to England, to his own Home at "Somerleaze." There in the South-West of England, in his own library, looking out upon his own land and trees, with his face toward the low-lying hills of Mendip, the historian of the Norman Conquest meditates upon the relation of Past and Present. That his thoughts occasionally go out from the old country to the new, is evident not only from his voluntary contribution to American past Politics, but from his sending to Baltimore, to the Seminary of Historical and Political Science, his most recent contributions to English magazines and newspapers, sources of present History.

Prospectus of the Series.

The following Studies are either ready for the press or in active preparation. Some of them will be published in the first instance by the University. Others will be reprints from the proceedings of learned societies, magazines, etc., where they appear in some cases under titles slightly different from those here adopted. The idea of this series is to bring together, in numbered monographs, kindred contributions to Historical and Political Science, so that individual efforts may gain strength by combination and become more useful as well as more accessible to students. The Studies will be published at convenient intervals, but not necessarily in separate form or in the following order. A limited edition only of each monographic number will be issued and a price will be set upon each as soon as it appears. A few single copies will be sold upon application and receipt of price. By paying three dollars in advance, subscribers may avoid the inconvenience of small remittances and be assured of receiving, at lower rates, the first twelve numbers, comprising more than twelve Studies and from 300 to 400 pages.

All business communications and questions touching exchanges should be addressed to Publication Agency, (N. Murray.) Johns Hopkins University, Baltimore, Md.; all scientific communications, to the Editor.

1. **An Introduction to American Institutional History.** By Edward A. Freeman, D.C.L., LL.D. With an account of Mr. Freeman's Visit to Baltimore, by the Editor, republished from the Johns Hopkins University Circular, No. 20. (Price, 25 cents).
2. **The Germanic Origin of New England Towns.** Read before the Harvard Historical Society, May 9, 1881. By H. B. Adams, Ph. D. Heidelberg, 1876; Associate Professor of History, Johns Hopkins University. With Notes on Cooperation in University Work. (Price, 40 cents).
3. **Saxon Tithingmen in America.** Read before the American Antiquarian Society, October 21, 1881. By H. B. Adams.
4. **Norman Constables in America.** Read before the New England Historic, Genealogical Society, February 1, 1882. By H. B. Adams.
5. **Village Communities in America — Cape Anne and Salem Plantations.** Read in part at a Field Meeting of the Essex Institute, August 31, 1881. By H. B. Adams.
6. **Local Government in Illinois.** Published in the Fortnightly Review, October, 1882. By Albert Shaw, A. B. Iowa College, 1879; Johns Hopkins University, 1881-2.
7. **Local Government in Pennsylvania.** Read before the Pennsylvania Historical Society, May 1, 1882. Published in the Pennsylvania Magazine of History and Biography, October, 1882. By E. R. L. Gould, A. B. Victoria University, 1881; Fellow in History, Johns Hopkins University, 1882.
8. **Origin and Development of the Municipal Government of New York City.** I. The Dutch Period. II. The English Period. Published in the Magazine of American History, May and September, 1882. By J. F. Jameson, Ph. D. Johns Hopkins University, 1882; Assistant in History, Johns Hopkins University.

(A fuller prospectus of the Series will be sent on application).

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[*] Epidauros in Dalmatia is now known as Ragusa Vecchia. Curiously enough, the mother-town has taken its daughter's name. It is as though England should assume the name, Old America.

[†] Reviewed in the *Nation*, February 9, 1882.

[‡] Mr. Evans has been for some years an authority upon affairs in South-Eastern Europe. His letters to the *Manchester Guardian* during the year 1877 have been published in book-form under the title of "Illyrian Letters — A revised selection of correspondence from the Illyrian provinces of Bosnia, Herzegovina, etc." (London, 1878.) An earlier work by Mr. Evans is entitled "Through Bosnia and the Herzegovina on foot during the insurrection, August and September, 1875" (Second edition, London, 1877).

[§] This motto is the pith of a sentence in Mr. Freeman's address in Birmingham, November 18, 1880, "On the Study of History," printed in the *Fortnightly Review*, March, 1881, p. 320, where he says it is "a highly practical truth that history is simply past politics and that politics are simply present history;" cf. p. 329. Another original form of the aphorism is: "History is the politics of the past, politics are the history of the present." Note also the same idea in Mr. Freeman's Lectures to American Audiences, p. 207: "Now the position for which I have always striven is this, that history is past politics, that politics are present history."

SYNOPSIS OF THE RECENT SCIENTIFIC JOURNALS

• Published here.

American Journal of Philology. Edited by Professor Gildersleeve. *Vol. III.* *Whole No.* 11.

Article I.—On the Culex and other Poems of the Appendix Vergiliana, by Robinson Ellis.

In this article Professor Ellis has discussed some thirty passages of the Culex, and has proposed emendations for most of them. He does not agree with Ribbeck and Bährens in supposing the Octavius to whom the poem is addressed to be any one but the youth who became later Octavianus and Augustus. "It is not necessary to suppose the poem actually written to the young Octavius." "A forger would naturally inscribe his Culex to Augustus, and as Virgil was supposed to have written it in boyhood, to Augustus, still a boy." V. 37, Professor Ellis would read 'memora*bimus haec* tibi *restet*,' v. 56, 57, 'illi somnia' for 'illis omnia.' He defends v. 58 'imaginis' against the proposed 'marginis,' reads v. 90 'duplicibus' for 'simplicibus,' suggests in v. 90 'in erectum' for 'inevectus,' and makes v. 157 the apodosis to v. 109 foll. For 'Tantum non horridus Hebrum' (v. 117) he suggests 'Non tantum Oeagrius' and restores the 'rare but not incredible' form 'platanūs' v. 124. On v. 158 'argutis et cuncta fremunt *ardore* cicadis' he admits the ingenuity of Bährens' 'a rore,' but prefers 'stridore,' referring to Plin. xi, 266 for 'stridor' as the regular word for the peculiar sound of the cicada. [The passage should in my judgment be let alone. It is incredible that the maker of the Culex should not have had present to his mind Ecl. 2, 18 'sole sub ardenti resonant arbusta cicadis,' to say nothing of the famous passage in Phaidros, 258 E: *καὶ ἅμα μοι δοκοῦσιν ὡς ἐν τῷ πνίγει ὑπὲρ κεφαλῆς ἡμῶν οἱ τέττιγες ᾄδοντες καὶ ἀλλήλοις διαλεγόμενοι καθορᾶν καὶ ἡμᾶς.*—B. L. G]. In v. 168 Professor Ellis would read 'Tollebant acres (?) venienti abdomina nisus;' v. 226 for 'vita' 'evicta.' He reconstructs 239 sqq., reads v. 288 'ire viam' for 'invitam' and v. 371 'lappis' for 'rapidis'—[a very satisfactory emendation].

Article II.—On the Creole Patois of Louisiana, by James A. Harrison.

Louisiana was settled by the French nearly two hundred years ago. To the French stock was added a medley of Romance-speaking races from every part of Mediterranean Europe, Spain, Portugal, and the Biscay regions. To these were superadded early in the last century large masses of Guinea and other negroes. The peculiar language of these people is the creole patois. The etymology of 'creole' is obscure; there is no obscurity about the thing, about the 'femme créole,' about the scope of the word 'créoliser.' The creole patois is a dialect that has sprung up almost entirely by the ear—word-jumbles half heard or entirely misunderstood and reproduced as the very staple and foundation of every-day indispensable speech. The people who speak this dialect still number hundreds of thousands. The whites speak it as well as the negroes, although the whites and many of the blacks speak pure French also.

The French negro of Louisiana has constructed from certain word-fragments and *débris* of conjugation an ingenious and intelligible scheme for the verb. He discards the copula as the Hebrew does, seizes upon the strong disjunctive form of the pronoun (moi, toi, lui) adds to it 'apé' (après), fuses the two ('mapé', 'tapé,' 'lapé,') follows these by an infinitive or quasi-infinitive and so makes a progressive present [like the Irish 'I am aft'her dinin']. On similar principles he makes an indefinite preterite, a future, a conditional. The infinitive plays an important part as in *lingua Franca* generally,—'ne' is dropped, 'pas' alone retained. Prepositions, conjunctions, non-essential or indeterminate words are cast overboard as useless luggage. The increasing nasalization going on in cultivated French is very obvious in Creole, the trill *l* is systematically ignored ('capab' for 'capable'). The article is often agglutinated. So 'ki lasoupe' = 'quelle soupe.' The omission of *de* and the use of *d* for the possessive are also noteworthy. [Compare the Greek *σχῆμα* Κολοφώνιον]. At the close of the article, which it is hard to summarize, Professor Harrison gives a specimen of a *conte nègre*, after Dr. Mercier, with an interlinear French version.

Article III.—On the English Perfect Participle used Infinitivally, by Fitzedward Hall.

A remarkable example of this usage occurs in a passage from Fuller: 'At this time,' writes Dr. Thomas Fuller, '*began* the troubles in the Low Countreys, about matters of religion, *heightned* between two opposing parties, Remonstrants and Contra-remonstrants,' etc. Quoting these words Dr. Peter Heylin objects: 'Not at this time, viz., 1618, which our author speaks of, but some years before. They were now come unto their height.' Dr. Fuller thereto replies: 'A causelesse cavil. I said not, absolutely, they now *began*, but now they *began heightned.* The animadvertor knows full well that such participles equivale infinitives . . . The troubles in the Low Countreys began heightned, that is *to heightned.* The distemper was bred some years before, which now came to the paroxism thereof, viz., *anno* 1618.' This gives an explicit recognition of the idiom which Dr. Hall exemplifies by numerous passages. So the use of the perfect participle by itself, or annexed to an auxiliary, for the present infinitive is proved by a long list of passages, from Robert Mannyng (1827–1838) to Dr. Johnson's Voyage to Abyssinia, p. 41, (ed. 1735), and an extract from George Villiers, cited in Dr. Priestley's Rudiments of English Grammar, etc., p. 127, (ed. 1768). The example from Dr. Johnson runs: 'He would have had us *taken* a road which was full of those people we were so much afraid of.' The next group of quotations exhibits the perfect participle, generally as a constituent of a tense but sometimes alone, instead of the perfect infinitive active. The first example is taken from Humphrey, Duke of Gloucester (1440), the last from Rev. Jeremy Collier, (The Emperor Marcus Antoninus, his Conversation with Himself, etc., (1701), p. lxxxix). 'This aversion, heightened by a vast ambition . . . . had like to broke out in the reign of Antoninus Pius.' Finally, the perfect participle has largely been put, by ellipsis, for the present infinitive passive. Extracts in substantiation of this follow, from Robert Mannyng already cited, to Milton (1670). Sundry locutions kindred to the outworn 'make him clepid' are still current. "These excepted, however, the idioms with which this paper is concerned are no longer recognized as of good repute, although what with ignorance and slovenry not all of them are disused," as in Mrs. Caudle's Curtain Lectures: 'You should have shown yourself a respectable man and have let him been sent to prison.'

Article IV—On the Athenian Naval Arsenal of Philon, by Thomas W. Ludlow.

On the 22d of last April there was found in the peninsula of Peiraieus an inscription of ninety-seven lines, in excellent preservation. This inscription contains the specifications for the construction of the famous Athenian naval arsenal known by the name of its architect, Philon, and mentioned incidentally by several ancient writers. Owing to the extreme importance and interest of this inscription, the text of it has been given in the *Journal*, with a translation and technical notes by Mr. Ludlow.

Article V.—Etymological Studies I., by J. P. Postgate.

Professor Postgate discusses, 1. The group *Mulciber*, *mulcere*, *marcus*, *marcere*, *μαλακός*. *Murcea*, *murcus*, *murceus*, *murcidus*, *μίμαρκυς*. Originally *mulcere*, 'to strike,' was the same as *mulcare*, 'to maul,' and the notion 'strike' is traced throughout. 2. *Σίβυλλα* does not come from *Σιό-βολλα* 'will of God,' but from *σιβ* which is seen in *σοφός* and *sapio*, *Σίβυλλα* being formed like Ἥρυλλα and others. Max Müller had partially anticipated Professor Postgate in this etymology, but in the present article new particulars have been added to the discussion. 3. *Flagitare* is traced from BHLAG, not from BHRAG (with Corssen), 'to beat frequently 'to importune' comp. *obtundo.* 4. *Formido*, *χάρμη*, *er χήρ*, *χαράσσω*, etc., come from GHAR (GHARS) 'prick' 'tear.' GHAR 'glow' for *χάρμη* 'fight,' (Curtius) does not satisfy the conditions. 5. *Incohare*, *cohum.* *Incohare* is bad spelling for *incohare; cohum* is the yoke-strap. 'To put the yoke-strap on the plough' well conveys the bare promise of completion which distinguishes *incohare* from *incipere.* *Cohum* itself comes from KAGH or KAKH, a parallel form to KAK, 'bind,' 'bend,' 'twist.'

The Reviews and Book Notices treat of *Verrall's Edition of the Medea of Euripides*—a minute examination of this noteworthy book—(J. H. Wheeler); *Halsey's Etymology of Latin and Greek*, (E. W. H); *Clarke's Report on the Investigations at Assos*, (Louis Dyer); *Schipper's Englische Metrik*—in detail—(James M. Garnett), and *Jahn's Aristides Quintilianus*, (A. S. G.)

Reports are given of *Zeitschrift der deutschen morgenländischen Gesellschaft*, *Journal Asiatique*, *Mnemosyne* and *Hermes.* In the *Correspondence* Dr. Hayman replies to some strictures of L. R. P., and L. R. P. makes a rejoinder to Dr. Hayman.

American Journal of Mathematics. Edited by Professor Sylvester. *Vol. V.* *No.* 2.

Article I.—On Subinvariants, *i. e.*, Semi-Invariants to Binary Quantics of an Unlimited Order—[Section 3, *Groundforms*, Analytical Deduction of their categories, (concluded). Section

4, *Perpetuants, i. e.*, absolutely irreducible subinvariants. *Excursus*, On Rational Fractions and Denumerants]—by J. J. Sylvester.

Article II.—Note on a Roulette, by A. V. Lane.

Article III.—A Memoir on the Abelian and Theta Functions, by Arthur Cayley.

Article IV.—On the non-Euclidean Geometry, by W. E. Story.

Studies from the Biological Laboratory of the Johns Hopkins University. *Vol. II. No.* 3.

Pp. 315 to 410, with plates XXV to XXIX inclusive. Also plate XIV belonging to Dr. Sternberg's article published in the preceding number. Abstracts of the papers contained in this number are given on pp 24, 25.

The Journal of Physiology. *Vol. III. Nos.* 5 and 6. Also second supplement to Vol. III.

(Published in America under the auspices of the Johns Hopkins University.)

Article I.—Optical Illusions of Motion, with one plate, by H. P. Bowditch and G. Stanley Hall.

Article II.—Reflex Movements of the Frog under the Influence of Strychnia, by G. L. Walton.

Article III.—A Contribution to our Knowledge of the Action of Certain Drugs upon Bodily Temperature, by H. C. Wood and E. T. Reichert.

Article IV.—Influence of Peptones and Certain Inorganic Salts on the Diastatic Action of Saliva, by R. H. Chittenden and J. S. Ely.

Article V.—On Cerebral Localization, by Sigmund Exner.

Article VI.—The Physiological Action of Methylkyanethine, by G. L. Walton.

Article VII.—On the Influence of Variations of Intra-Cardiac Pressure upon the Inhibitory Action of the Vagus Nerve, by Henry Sewall and Frank Donaldson.

(An abstract of this paper is given on page 25).

Article VIII.—Preliminary Observations on the Innervation of the Heart of the Tortoise, by W. H. Gaskell.

Article IX.—Concerning the Influence exerted by each of the Constituents of the Blood on the Contraction of the Ventricle, with one plate, by Sydney Ringer.

The supplement contains a list of the titles of Books and Papers on subjects of physiological interest which were published in 1881.

Editorial communications should be sent to Dr. Michael Foster, Sec. R. S., New Museums, Cambridge, England. Business communications to Dr. W. T. Sedgwick, Johns Hopkins University, Baltimore.

Preface to Contributions to Logic by Members of the Johns Hopkins University. C. S. Peirce, Editor. (Little, Brown & Co., Boston, 1882).

These papers, the work of my students, have been so instructive to me, that I have asked and obtained permission to publish them in one volume.

Two of them, the contributions of Miss Ladd (now Mrs. Fabian Franklin) and Mr. Mitchell, present new developments of the logical algebra of Boole. Miss Ladd's article may serve, for those who are unacquainted with Boole's "Laws of Thought," as an introduction to the most wonderful and fecund discovery of modern logic. The followers of Boole have altered their master's notation mainly in three respects.

1. A series of writers,—Jevons, in 1864; Peirce, in 1867; Grassman, in 1872; Schröder, in 1877; and McColl in 1877,—successively and independently declared in favor of using the sign of addition to unite different terms into one aggregate, whether they be mutually exclusive or not. Thus, we now write

$$\text{European} + \text{Republican};$$

to stand for all Europeans and Republicans taken together, without intending to count twice over the European Republicans. Boole and Venn (his sole living defender) would insist upon our writing

$$\text{European} + \text{Non-European Republican},$$

or

$$\text{Non-Republican European} + \text{Republican},$$

The two new authors both side with the majority in this respect.

2. Mr. McColl and I find it to be absolutely necessary to add some new sign to express *existence*; for Boole's notation is only capable of representing that some description of thing does *not* exist, and cannot say that anything *does* exist. Besides that, the sign of equality, used by Boole in the desire to assimilate the algebra of logic to that of number, really expresses, as De Morgan showed forty years ago, a complex relation. To say that

$$\text{African} = \text{Negro},$$

implies two things, that every African is a Negro, and that every Negro is an African. For these reasons, Mr. McColl and I make use of signs of inclusion and of non-inclusion. Thus, I write

$$\text{Griffin} \prec \text{breathing fire}$$

to mean that every griffin (if there be such a creature) breathes fire; that is, no griffin not breathing fire exists; and I write

$$\text{Animal} \;\overline{\prec}\; \text{Aquatic},$$

to mean that some animals are not aquatic, or that a non-aquatic animal does exist. Mr. McColl's notation is not essentially different.

Miss Ladd and Mr. Mitchell also use two signs expressive of simple relations involving existence and non-existence; but in their choice of these relations they diverge both from McColl and me, and from one another. In fact, of the eight simple relations of terms signalized by De Morgan, Mr. McColl and I have chosen two, Miss Ladd two others, Mr. Mitchell a fifth and sixth. The logical world is thus in a situation to weigh the advantages and disadvantages of the different systems.

3. The third important modification of Boole's original notation consists in the introduction of new signs, so as to adapt it to the expression of relative terms. This branch of logic which has been studied by Leslie Ellis, De Morgan, Joseph John Murphy, Alexander MacFarlane, and myself, presents a rich and new field for investigation. A part of Mr. Mitchell's paper touches this subject in an exceedingly original and interesting way.

The method of using the Boolian calculus—already greatly simplified by Schröder and by McColl—receives still further improvements at the hands both of Miss Ladd and Mr. Mitchell, and it is surprising to see with what facility their methods yield solutions of problems more intricate and difficult than any that have hitherto been proposed.

The volume contains two other papers relating to deductive logic. In one of these Mr. Gilman develops those rules for the combination of relative numbers, of which the general principles of probabilities are special cases. In the other, Dr. Marquand shows how a counting machine, on a binary system of numeration, will exhibit De Morgan's eight modes of universal syllogism.

There are, besides, two papers upon inductive logic. In the first, Dr. Marquand explains the deeply interesting views of the Epicureans, known to us mainly through the work of Philodemus, *περὶ σημείων καὶ σημειώσεων*, which exists in a fragmentary state in a Herculaneum papyrus.

The other paper is one which, at the desire of my students, I have contributed to the collection. It contains a statement of what appears to me to be the true theory of the inductive process, and the correct maxims for the performance of it. I hope that the thoughts that a long study has suggested to me may be found not altogether useless to those who occupy themselves with the application of this kind of reasoning.

I have to thank the Trustees of the Johns Hopkins University, for a very liberal contribution toward the expenses of this publication.

C. S. PEIRCE.

Baltimore, December 1, 1882.

Professor Cayley's Introduction to a Memoir on the Abelian and Theta Functions.

[*To appear in the American Journal of Mathematics, Vol. V, No.* 2].

The present memoir is based upon Clebsch and Gordan's *Theorie der Abelschen Functionen*, Leipzig, 1866, the employment of differential rather than of integral equations is a novelty; but the chief addition to the theory consists in the determination which I have made for the cubic curve, and also (but not as yet in a perfect form) for the quartic curve, of the differential expression $d\Pi_{\xi\eta}$ (or as I write it $d\Pi_{12}$) in the integral of the third kind $\int_a^\beta d\Pi_{\xi\eta}$ in the final normal form (endliche Normalform) for which we have (p. 117) $\int_\xi^\eta d\Pi_{\alpha\beta} = \int_a^\beta d\Pi_{\xi\eta}$ the limits and parametric points interchangeable. The want of this determination presented itself to me as a *lacuna* in the theory during the course of lectures on the subject which I had the pleasure of giving at the Johns Hopkins University, Baltimore, U. S. A., in the months January to June, 1882, and I succeeded in effecting it for the cubic curve, but it was not until shortly after my return to England that I was able partially to effect the like determination in the far more difficult case of the quartic curve. The memoir contains, with additional developments, a reproduction of the course of lectures just referred to. I have endeavored to simplify as much as possible the notations and demonstrations of Clebsch and Gordan's admirable treatise; to bring some of the geometrical results into greater prominence; and to illustrate the theory by examples in regard to the cubic, the nodal quartic, and the general quartic curves respectively. The present three chapters are: I, Abel's Theorem; II, Proof of Abel's Theorem; III, The Major Function. The paragraphs of the whole memoir will be numbered continuously.

Meeting of the German Philologians.

(*Communicated by* MR. H. C. G. BRANDT).

The following account of the thirty-seventh meeting of German Philologians and Teachers, written by a former member of this University, was received too late for insertion in the last number of the *American Journal of Philology* and is published here, where it will receive a wider circulation:

The thirty-seventh meeting of German Philologians and Schoolteachers was held in Karlsruhe from the 27th to the 30th of September. Nearly 600 members attended, coming mainly from Baden, Würtemberg, and Alsace-Lorraine, which shows that the Association is by no means national. The meeting was postponed last year, because the city of Karlsruhe could not well entertain the guests, having just celebrated the marriage of the daughter of the Grand Duke. This year also it was a question in many minds whether a meeting once in two years was not enough, "because the burden imposed upon the city chosen as the place of meeting was so great."

The division into sections is a practical feature which spares one the tiresome hearing of a strictly special paper of a department not one's own. But very long special papers also turn up in the general sessions—and turn out the audience. The sections met daily from 8–10 a. m. in the classrooms of the Gymnasium. The general sessions were held in the large "Festhalle" of the city, beginning at 10 a. m.

The addresses and papers before the general sessions were as follows:

1. Opening address by the presiding officer, Director Dr. Wendt of Karlsruhe, who discussed the pedagogical questions of the day, chief among which is that of "Greek in the Gymnasium." Since the "Realschulverein" is a separate body, there could be only one opinion upon that subject among those present. According to the latest Prussian regulations, Greek has been banished from Quarta, but outside of Prussia Greek still holds its own.

2. Director Genthe of Hamburg read a paper on "The relations of the Greeks and Romans to the Baltic." The reader claimed that the first communication of our ancestors with the South of Europe was not by sea but by land. Pytheas of Massilia only touched the coast of Holstein. The Southern Europeans went overland, following the streams that flow into the Black Sea and those that flow into the Baltic. Antiquities, frequently found, confirm the existence of an ancient highway.

3. Professor Ernst Curtius gave an address upon the "Excavations at Olympia," illustrated by charts and plastercasts.

4. Professor Studemund spoke "Ueber zwei Parallelkomödien des Diphilus." He reconstructed the whole play of the "Vidularia" of Plautus, and from the reading of a very badly damaged palimpsest, fac-similes of which were distributed among the audience, tried to prove that the "Vidularia" was also an imitation of a comedy of Diphilus, the companion piece of the Greek original of the "Rudens."

5. Dr. Hettner, Director of the Provincial Museum of Trier, read a paper on the "Civilization of Gaul and Germany under Roman rule."

6. Dr. Max Koch of Marburg "On the relation of German to English Literature in the 18th century."

7. Professor Ziegler of Strassburg "Ueber die Entstehung der Alexandrianischen Philosophie."

8. Dr. Soltau of Zahern "Ueber den Ursprung von Census und Censur in Rom." The Census was instituted for military, the Censorship for political purposes.

9. A eulogy on Hermann Köchly by Prof. Dr. Boeckel of Karlsruhe.

The pedagogical section had the largest representation, counting 179 members. Here, too, the burning question of Latin and Greek in the Gymnasium was the chief topic of discussion. The oriental section, which is identical with the German Oriental Society, held its business meetings and heard papers: on the text of Ezekiel; and on the relation of Old Semitic to Egyptian writing and to the Runes.

The "philological" section *par excellence* was presided over by Professor Schöll of Heidelberg, and heard

1. "Mitteilungen über die handschriftliche Kritik der Xenophontischen Kyropädie, insbesondere über Cod. Paris. 1640 (c)," by Professor Hug of Zürich.

2. "Ueber die Benutzung altklassischer Autoren durch einige Chronisten des Mittelalters."

3. "Ueber die Quantitätslehre Herodians."

4. "Ueber die Gliederung der im Cod. Palatinus erhaltenen Sammlung der Anacreontea," by pupils of Studemund.

The archæological and "philological" sections combined heard a more minute description of the east pediment of the temple at Olympia, by Professor Curtius, and a paper on the line of retreat of the Athenians (from Syracuse) in 413, by Professor Holm of Palermo.

The Germanic-Romance section which numbered 52 members, but very few Romance scholars, was presided over by Geheimer Hofrat K. Bartsch.

The following papers were read:

1. By Geh. Hofrat Dr. Bartsch of Heidelberg, "Die Gründung germanischer und romanischer Seminare und die Methode kritischer Uebungen."

2. By Professor Dr. Bechstein of Rostock, "Die Floia, das älteste maccaronische Gedicht der deutschen Litteratur."

3. By Mr. Armitage, "Ueber die Deklination der parisyllabica masculina mit drei Endungen im Provençalischen."

4. Archivrat Wülker of Weimar, "Ueber Luthers Stellung zur kursächsischen Kanzlei."

5. Dr. Max Rieger of Alsbach, "Ueber Klingers Goldenen Hahn."

6. Dr. Rieger of Darmstadt, "Ueber Klingers Goldenen Hahn."

7. Prof. Dr. Fischer of Stuttgart, "Ueber den Vokalismus des schwäbischen Dialect."

8. Privatdocent Dr. Kluge of Strassburg, "Ueber deutsche Etymologie."

The first Germanic-Romance seminary was founded in Heidelberg, 1869. But now such a combination is not considered practical. In Strassburg English and Romance seminaries are still united. Dr. Bechstein thought it likely that the father of the Low German poet Lauremberg was the author of the "Floia." Dr. Fischer attempted to analyze sounds without being a phonetist. Archivrat Wülker's was a very valuable paper. The author, by reason of his position, has peculiar advantages for investigating the origin of the "neuhochdeutsche schriftsprache," a subject by no means so plain and simple as grammarians think who begin "Luther ist bekanntlich der Gründer und Vater unserer neuhochdeutschen Schriftsprache." Dr. Kluge discussed the methods, which he has followed in his new "Etymologisches Wörterbuch der Deutschen Sprache." That these methods are sound and are those advocated by the "Junggrammatiker," is evident from the two fascicles of the work which have so far appeared.

The section of Modern Languages had been but recently organized. In several sessions the present state of English grammars was discussed.

RECENT PUBLICATIONS.

Brooks, W. K. The Development of Lucifer. (Royal Society, London, Philosophical Transactions, 1882, pp. 80, 4°.; 11 plates.)

It has been known, since Fritz Müller's researches on the metamorphosis of Penaeus, that a few decapod crustacea have preserved their ancestral life-history almost without modification, but up to the present time no one had actually traced such a life-history, step by step, from embryo reared in aquaria. Certain naturalists have therefore refused to accept the generalizations which have been based on Fritz Müller's observations.

Lucifer is a pelagic decapod crustacean which passes through a metamorphosis which is almost exactly like that in Penaeus described by Müller from captured larvae.

The present paper, illustrated by eleven plates, and nearly a hundred figures, is an account of its life-history based upon the study of isolated specimens which were reared from the egg.

It is impossible to give an abstract of the paper without figures, but its interest to embryologists is shown by the fact that most of the results have already been republished in this country, as part of the series of "Selections from Embryological Memoirs," which are now issuing from the Museum of Comparative Zoölogy of Cambridge.

Browne, W. Hand. The Clarendon Dictionary of the English Language. [Prepared with the assistance of the late Professor S. S. Haldeman]. (University Publishing Co., N. Y., 1882, pp. 380, 16°.)

"In the preparation of this dictionary an attempt has been made to combine, as far as possible, the qualities of accuracy, clearness, and conciseness, so as to include in the smallest compass the largest usefulness.

"In the preparation of the definitions, the leading authorities, both English and American, as well as the standard technical and scientific text-books and encyclopaedias, in their latest editions, have been consulted, and the various meanings in current usage given as clearly and in as few words as possible. As a dictionary, by its very nature, has of all books the least pretence to orginality, wherever the compiler has found a definition that seemed the best possible for his purpose, he has adopted it; but where it seemed practicable to frame a definition more accurate, clear, or concise than any of those offered, he has endeavored to do so. The leading meaning is usually placed first, and the others in the order of their divergence. When, from etymological or other reasons, one meaning or series of meanings seems entirely disconnected from the preceding, the distinction is marked by a colon.

"Of course, in a work of this kind, obsolete or dialectic words, or the special terminologies of art and science cannot be given, but it is believed that its vocabulary contains all words that are in general use, or that are likely to be met with in any but special treatises.

"The pronunciation was prepared by the late Prof. S. S. Haldeman, whose extensive knowledge of linguistics and phonology especially qualified him for the task. The symbolism adopted is simple and easy, and the key-words (at the foot of each page) are such, it is believed, as are pronounced alike by all, or nearly all, speakers of English." [*From the Preface*].

Gildersleeve, B. L. Latin Primer. (University Publishing Co., N. Y., 1882, pp. 208, 12°.)

This thoroughly revised and partly recast edition of the Latin Primer, (published in 1875), has been prepared by Professor Gildersleeve in conjunction with Professor Chapman Maupin.

HOPKINS HALL LECTURES.

V.

ETCHERS AND ETCHING.

Mr. F. Seymour Haden, F. R. C. S., England, will give three lectures on Etchers and Etching, on Tuesday, Wednesday, and Thursday, January 2, 3, and 4.

The following subjects will be treated:

I. The Principles of Etching.
II. The Practice of Etching.
III. The Great Masters of Etching.

The course will be illustrated by diagrams and examples.

An article, by Mr. Philip Gilbert Hamerton, on Mr. Haden's Etchings may be consulted in Scribner's Monthly for August, 1880.

VI.

FRENCH LITERATURE.

M. Rabillon, Lecturer in French. (*In French*). Lectures, and readings with comments, in Modern French Literature, beginning Saturday, January 13, and continuing on successive Saturdays till further notice.

VII.

PHILOSOPHY AND CHRISTIANITY.

Professor George S. Morris, Lecturer on the History of Philosophy. Eight lectures which were prepared for delivery on the Ely foundation, in the Union Theological Seminary of New York City.

The object of this course is, in brief, to institute a comparison between what may be termed the philosophic presuppositions of Christianity, and the historic results of philosophic inquiry.

The dates of the lectures are as follows:

I. Monday, January 8.
II. Tuesday, January 9.
III. Monday, January 15.
IV. Tuesday, January 16.
V. Monday, January 22.
VI. Tuesday, January 23.
VII. Monday, January 29.
VIII. Tuesday, January 30.

VIII.

ON POETRY

As an Embodiment of the Spiritual, and an Interpretation of Life.

Professor **Hiram Corson**, LL. D., of Cornell University. Ten lectures:

I. Wednesday, January 10.
II. Thursday, January 11.
III. Friday, January 12.
IV. Wednesday, January 17.
V. Thursday, January 18.
VI. Friday, January 19.
VII. Wednesday, January 24.
VIII. Thursday, January 25.
IX. Friday, January 26.
X. Wednesday, January 31.

Five lectures of the course will be devoted to the Æsthetics of English verse and prose, and five lectures to the poetry of Alfred Tennyson, Robert Browning, and Elizabeth Barrett Browning, as embodying the highest nineteenth century ideals of individual life and of spiritual vitality.

A detailed exposition of the subjects treated in the course will be given later.

Particulars in regard to the following courses will be hereafter announced:

1. *Pedagogics.* **Professor G. Stanley Hall**, Ph. D., Lecturer on Psychology. Ten lectures, beginning early in February.
2. *Anglo-Saxon Poetry.* **Professor James A. Harrison**, of Washington and Lee University. Ten lectures, Mondays, Wednesdays, and Fridays, February 12 to March 2.
3. *English Literature.* **Mr. George W. Cable**, of New Orleans. Six lectures, Mondays, Wednesdays, and Fridays, March 5 to 16.

SPECIAL LECTURES FOR ADVANCED STUDENTS.

I.

LECTURES ON PHYSIOLOGY.

A course of advanced lectures on Physiology and allied subjects, primarily designed for graduate students in the Biological Department of the university, will be delivered by Professor H. N. MARTIN and his co-workers in the Biological Laboratory of the Johns Hopkins University, on Tuesdays and Thursdays in the early part of the year 1883. Physicians desiring to attend the course can obtain tickets on application at the Treasurer's Office. A registration fee of one dollar will be charged for each ticket. The lecture hour will be 1.15 p. m.

The lectures will be as follows:

I. *January 9, 11, 16, 18, 23, 25.* Six lectures by PROFESSOR MARTIN, on "Animal Heat and the Physiology of Fever."

II. *January 30, February 1.* Two lectures by DR. W. T. COUNCILMAN, on "Splenic Fever, as illustrating the relationship of bacterial organisms to the production of infectious disease."

III. *February 6, 8, 13.* Three lectures by DR. W. T. SEDGWICK, on "The Physiology of Reflex Actions."

IV. *February 15, 20.* Two lectures by MR. H. H. DONALDSON, on "The Influence of Digitaline upon the Circulatory Organs."

V. *February 27, March 1.* Two lectures by MR W. H. HOWELL, on "The Influence of the Respiratory Movements on the Circulation of the Blood."

VI. *March 6, 8.* Two lectures by MR. H. N. STOKES, on "The Physiological Relationships of Urea."

VII. *March 13.* A lecture by DR. W. T. SEDGWICK, "On some points in the Physiological Action of Quinine."

Attendants on these lectures will be assumed to have a general knowledge of the fundamental facts established in regard to the various topics discussed. The lectures will be partly based on recent original researches of the lecturers, and will also give a critical resumé of recent publications on the various subjects.

II.

HISTORICAL LECTURES ON CHEMISTRY.

A course of lectures will be given during January and February by Professor REMSEN and his co-workers in the Chemical Laboratory. The object of the course is two-fold: to direct attention to subjects which have played important parts in the development of Chemistry, and also to afford the Fellows and advanced students an opportunity to practice the art of lecturing.

The topics for the students have been selected by the Professor of Chemistry. The lectures are to be based upon thorough study of the original investigations which have been the means of developing the subjects discussed.

A list of the papers studied and a clear abstract of the lectures will be prepared, and these will be preserved for the use of future students.

The lectures this year will be as indicated below. They will be given on Wednesdays and Thursdays at 11 a. m., as follows:

I. *January 10, 11.* Two lectures by MR. E. H. KEISER, on "The History of Ozone."

II. *January 17, 18.* Two lectures by MR. D. T. DAY, on "The Electro-chemical Theory."

III. *January 24, 25.* Two lectures by MR. W. C. DAY, on "Avogadro's Hypothesis."

IV. *January 31, February 1.* Two lectures by MR. H. N. STOKES, on "The Idea of the radical in Chemistry."

V. *February 7, 8.* Two lectures by PROFESSOR REMSEN, on "Valence."

VI. *February 14, 15.* Two lectures by J. R. DUGGAN, M. D., on "Fermentation."

VII. *February 28, March 1.* Two lectures by DR. H. N. MORSE, on "The Significance of Chemical Formulas in the early periods of the Science."

VIII. *March 7, 8.* Two lectures by DR. R. D. COALE, on "The Investigations which led to the Conception of Substitution."

The lectures will be given in the main lecture-room of the chemical laboratory. Members of the University who may be interested are invited to attend. Other persons desiring to do so may address Professor Remsen.

CURRENT INFORMATION.

Dr. Hastings gave a lecture on the Transit of Venus, on Friday, December 1, illustrated with diagrams, an artificial transit, and maps, and he described the part which would be taken by this University in observing this event. An introductory historical statement was given by President Gilman, and the evening closed with a social assembly of the students of mathematics and physics and their friends, who were invited to meet the Trustees and Faculty.

At the recent meeting of the National Academy of Sciences, in New York, papers were read by Professor Remsen, on Sinapic Acid; on the Influence of Magetism on Chemical Action; on White Phosphorus, (see p. 24). These papers will be prepared for publication in the American Chemical Journal. Papers were also read by Mr. C. S. Peirce.

The Library of the late Professor Bluntschli, of Heidelberg, presented to the University by the Germans of Baltimore, was formally received by the University at a gathering of the Trustees, Faculty, and students of historical and political science, in Hopkins Hall, Wednesday, December 20.

At the meeting of the Historical Seminary, Friday, December 8, Hon. J. H. B. Latrobe, President of the Maryland Historical Society, was present and gave an interesting statement of his reminiscences of Madison, with allusions to Monroé, Jefferson, Charles Carroll, Webster, Clay, and other statesmen.

The Copley Medal of the Royal Society has been awarded to Arthur Cayley, Professor of Mathematics in the University of Cambridge, England.

A list of those who have received this honor, during the last twenty years, is given in No. 7 (page 86) of these Circulars.

The Rumford Medal has been awarded to Captain W. DeW. Abney, R. E., F. R. S.

RECENT APPOINTMENTS, Etc.

PROFESSOR MAUPIN, Examiner in Latin, has resigned his position in the Baltimore City College, to take charge of the school at Ellicott City, formerly directed by PROFESSOR J. M. GARNETT, who has become Professor of English in the University of Virginia.

PROFESSOR H. E. SHEPHERD, late Superintendent of Schools of Baltimore, has accepted the position of President of Charleston College, S. C.

ALBERT S. COOK, Ph. D., (Jena), 1882, Associate in English, 1879-81, has entered upon his duties as Professor of English in the University of California.

CHASE PALMER, Ph. D., 1882, is acting as Assistant in Chemistry in the Massachusetts Institute of Technology.

C. C. NORWOOD, A. B., (Davidson), 1878, and Graduate Student here, 1879-82, has been appointed Professor of Mathematics in the Maryland Agricultural College.

E. M. HARTWELL, Ph, D., 1881, has been appointed Instructor in Physical Culture.

H. F. REID, A. B., 1880, has been appointed Assistant in Physics.

E. H. KEISER, S. B., Swarthmore College, 1880, has been nominated as a Fellow in Chemistry.

DIED.

On November 4, 1882, Dr. JULIUS FRIEDLÄNDER, of the firm of R. Friedländer & Son, agents in Berlin for the publications of this University.

On November 2, 1882, in the twenty-fifth year of his age, F. BOWMAN DOSH, who was a matriculated student of this University, 1879-81, and has recently been pursuing the study of Medicine in Washington. He had been engaged for some time in the service of the Department of Agriculture in Washington, where he had won an honorable name.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

November 1.—Professor Sylvester in the chair. Forty members present.

Papers read:

- On a Newly Recognized Agent in Geological Change, by C. S. Hastings.
- On the Lower Organisms in their Relation to Disease, by W. T. Councilman. (*Abstract on p.* 24).
- On White Phosphorus, by I. Remsen. (*Abstract on p.* 24).

Officers for the year were elected as follows:

President, Professor Sylvester; Vice-President, Professor Remsen; Secretary, H. H. Donaldson; Standing Committee, Dr. F. Franklin, Dr. R. D. Coale, H. F. Reid.

December 6.—Professor Sylvester in the chair. Forty-four members present.

Papers read:

- On the Transit of Venus, by C. S. Hastings.
- Notes from the Biological Laboratory, by W. T. Sedgwick.

Philological Association.

October 6.—Professor Gildersleeve in the chair. Twenty-eight members present.

Papers read:

- On Aesthetic and Grammar, by B. L. Gildersleeve. (*Abstract on p.* 5).
- On the Locality of the Treatise of Palladius de Agri Cultura, by J. R. Harris. (*Abstract on p.* 6).
- On a Probable Error in Plutarch, by C. D. Morris. (*Abstract on p.* 6).

November 3.—Professor Gildersleeve in the chair. Thirty-three members present.

Papers read:

- On a Search for Functional and Dialectic Differences in the Present Systems of the Veda, by M. Bloomfield. (*Abstract on p.* 26).
- On Matthew Arnold's Poetry Test, by W. J. Alexander. (*Abstract on p.* 26).
- On the use of ὅτι (or ὡς) in Direct Quotations, by E. H. Spieker. (*Abstract on p.* 26).

December 8.—Professor Gildersleeve in the chair. Thirty-three members present.

Papers read:

- On Quantity in English Verse and the use of the Hexameter, by A. H. Tolman.
- Review of Professor Harrison's French Syntax, by B. F. O'Connor.
- A Note on the Chalcidians, by C. D. Morris.
- On a Fragment of the Cura Pastoralis, by J. W. Bright.

Historical and Political Science Association.

Monthly meetings.

October 20.—Dr. H. B. Adams in the chair. Twenty-seven persons present.

Papers read:

- The Past and Present of Political Economy, by R. T. Ely. (*Abstract on p.* 27).
- Review of Rogers' History of Agriculture and Prices in England (1259–1773), by A. Yager.

November 17.—Dr. H. B. Adams in the chair. Twenty-three persons present.

Papers read:

- Political Economy in Germany in 1882, by R. T. Ely. (*Abstract on p.* 27).
- Review of Economic Science in America since 1876, by B. J. Ramage.
- Review of E. G. Scott's Development of Constitutional Liberty in the English Colonies of America, by Edward Ingle.
- Notes on Cooperation in University Work, by H. B. Adams. (*Printed in Hist. and Pol. Studies, ii*).

Weekly meetings—October.

- Edward A. Freeman's Introduction to American Institutional History, read by H. B. Adams. (*Abstract on p.* 26).
- Brief Report of the Annual Meeting of the American Social Science Association, by E. W. Bemis.
- Report of Summer Study in Quebec, by E. R. L. Gould.
- Report of a Tour through Virginia, by Messrs. Wilhelm and Ingle.
- From a Connecticut Town to a South Carolina Parish: a Comparative Study of Local Records, by B. J. Ramage.
- Local Government in the Northwest, by E. W. Bemis. (*Abstract on p.* 28).
- Review of the Pennsylvania Magazine of History and Biography, by E. R. L. Gould.
- Mr. Freeman's Visit to Baltimore, by H. B. Adams. (*See p.* 28. *Reprinted in the Hist. and Pol. Studies, i*).

Weekly meetings—November.

- The District System of South Carolina, by B. J. Ramage. (*Abstract on p.* 28).
- Plymouth Rock Restored, by H. B. Adams. (*Abstract on p.* 28. *See also Magazine of American History, December*, 1882, *and January*, 1883).
- Report on the *Revue Historique*, by J. F. Jameson.
- Reports on an Excursion, November 23, 1882, to Joppa, Maryland, the original Shire Town of Baltimore County and the first seat of St. John's Parish, by the Rev. Dr. Leakin, H. B. Adams, Edgar Goodman, and L. W. Wilhelm.
- Reviews (written by request for local publication in Baltimore and posted for the benefit of the Seminary): Müller's Political History of Recent Times, by E. R. L. Gould; Walpole's Short History of Ireland, by E. W. Bemis; Cox on Sher
March to the Sea, and Jones on De Soto's March through Georgia, by B. J. Ram
Henry Adams' John Randolph (American Statesmen Series), by Edward I
Warburton's Edward III., and Myers' Outlines of Ancient History, by J. F. Jam

Mathematical Society.

October 18.—Professor Sylvester in the chair. Twenty members present.

Papers read:

- On Certain Successions of Integers that cannot be Indefinitely Continued, by Sylvester. (*Abstract on p.* 2).
- On a Class of Multiple Algebras, by C. S. Peirce. (*Abstract on p.* 3).
- On Crocchi's Theorem, by J. J. Sylvester. (*Abstract on p.* 2).
- On Crocchi's Theorem, by F. Franklin. (*Abstract on p.* 24).
- On a Geometric Locus, by G. S. Ely.

Mr. W. P. Durfee was appointed Secretary of the Society for the ensuing year.

November 15.—Professor Sylvester in the chair. Twenty members present.

Papers read:

- On a Fundamental Theorem in the New Method of Partitions, by J. J. Sylv
(*Abstract on p.* 22).
- On the Maximum Value of a Certain Determinant, by E. W. Davis. (*Abstract on*
- On the Tabulation of Symmetric Functions, by W. P. Durfee. (*Abstract on p.* 2
- On the Expression for the Volume of a Tetrahedron in Terms of its Edges,
Franklin.

Metaphysical Club.

November 14.—Mr. Peirce in the chair. Seven members present.

Mr. Peirce made some opening remarks explaining the object of the Club, and
tioning as suitable subjects for treatment the Data of Ethics and Spurious Proposi

Mr. McDaniel read a paper on Samuel Tyler, a member of the Baltimore Bar,
wrote on philosophical subjects.

Officers were then elected for the ensuing year:

President, Prof. G. S. Morris; Secretary, Mr. J. M. Cattell; third member of th
ecutive Committee, Mr. J. Jastrow.

December 12.—Professor G. S. Morris in the chair. Twenty-three members presen

Papers read:

- University and Philosophy, by G. S. Morris.
- Knowledge and the Relativity of Feeling, by J. Dewey.
- On the recent Philosophical Journals, by J. M. Cattell.

Baltimore Naturalists' Field Club.

During the winter nearly all field work necessarily ceases; the regular monthly
ings of the Club will therefore be discontinued until the spring. The various se
may, however, hold meetings to discuss any matters which may be of special in
to them.

At intervals during the winter lectures are to be given before the Club on selected
in Natural Science. The first of this course was delivered by Prof. H. Newell M
in Hopkins Hall, November 27th, on *The Life and Work of Charles Darwin*. The ad
was mainly biographical. The character and influence of Mr. Darwin's work
the estimate that had been placed upon them by leaders in different departme
science were also considered.

The next lecture will be given early in January by Mr. P. R. Uhler, President
Maryland Academy of Sciences, on *The Geology of the Surface Features of the Bal
Area.*

Many features in the neighborhood of the city, of physiographical or geological int
are undergoing rapid change owing to the disintegration of the rock and other c
A moderate sum has been appropriated by the University for the purpose of obta
photographs of such localities as are of special geological interest.

Some additions have been made to the collections of the club. Mr. D. T. D
brought some very interesting specimens of snakes and insects from Florida.
Geological and Mineralogical branch has been very active, collecting minerals
neighborhood of Baltimore.

Maryland Historical Society.

October 10.—The President, Hon. J. H. B. Latrobe in the chair.

Paper read:

- Historical Sketch of Bohemia Manor, by G. A. Leakin.

November 13.—The President in the chair.

Paper read:

- A Recent Study of the Life of James Monroe, by D. C. Gilman.

December 11.—The President in the chair.

Paper read:

- The Old Towns of Maryland, by L. W. Wilhelm.

HOURS.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
A. M. 9	General Chemistry. (Remsen.) Greek Prose. (C. D. Morris.) Latin Prose. (Spieker.) Analyt. Chemistry. (Coale.)	General Chemistry. (Remsen.) Plato. (C. D. Morris.) Livy. (Spieker.) Sanskrit: Com. Gram. (Bloomfield.) Analyt. Chemistry. (Coale.)	General Chemistry. (Remsen.) Plato. (C. D. Morris.) Livy. (Spieker.) Logic. (Peirce.) Calculus of Variations. (Craig.) Physics: Major. (Hastings.) Laboratory work, 9 a. m. to 5 p. m. Mineralogy. (Morse.) (9–12.)	General Chemistry. (Remsen.) Plato. (C. D. Morris.) Livy. (Spieker.) Mineralogy. (Morse.) (9–12.)	General Chemistry. (Remsen.) Plato. (C. D. Morris.) Livy. (Spieker.) Logic. (Peirce.) Calculus of Variations. (Craig.) Mineralogy. (Morse.) (9–12.)	
10	Physics. (Hastings.) Latin Prose. (C. D. Morris.) Physiology. (Martin.) Definite Integrals. (Craig.) Elocution. (Woodworth.) (10-1.)	Physics. (Hastings.) Greek Comp. (Gildersleeve.) Tacitus. (C. D. Morris.) Physiology. (Martin.) Anal. Geom.: Adv. (Story.) Solid Anal. Geom. (Franklin.) Elocution. (Woodworth.) (10-1.)	Physics. (Hastings.) Tacitus. (C. D. Morris.) Anal. Geom.: Adv. (Story.) Sanskrit: Adv. (Bloomfield.) Elocution. (Woodworth.) (10-1.)	Physics. (Hastings.) Tacitus. (C. D. Morris.) Physiology. (Martin.) Definite Integrals. (Craig.) Solid Anal. Geom. (Franklin.) Elocution. (Woodworth.) (10-1.)	Physics. (Hastings.) Greek Comp. (Gildersleeve.) Tacitus. (C. D. Morris.) Physiology. (Martin.) Anal. Geom.: Adv. (Story.) Solid Anal. Geom. (Franklin). Elocution. (Woodworth.) (10-1.)	German Literature. (Wood.) (Alternate Saturdays.) Sanskrit: Adv. (Bloomfield.)
11	General Biology. (Sedgwick.) German: Major. (Bright.) Latin Prose. (Warren.) Greek Prose. (Spieker.) Calculus. (Franklin.) Early English. (Wood.) Philos. Seminary. (G. S. Morris.) French: Major. (Elliott.)	Osteology. (Brooks.) German: Major. (Bright.) Latin Seminary. (Warren.) Xenophon. (Spieker.) Elliptic Functions. (Craig.) Calculus. (Franklin.) Hist. of Philos. (G. S. Morris.) French: Major. (Marcou.)	General Biology. (Sedgwick.) Cicero. (Warren.) Xenophon. (Spieker.) Elliptic Functions. (Craig.) Calculus. (Franklin.) Gothic. (Wood.) Hist. of Philos. (G. S. Morris.) Romance Lang.: Adv. (Elliott.) French: Major. (Marcou.)	Osteology. (Brooks.) German: Major. (Bright.) Xenophon. (Spieker.) Calculus. (Franklin.) Early English. (Wood.) Philos. Seminary. (G. S. Morris.) French: Major. (Elliott.)	General Biology. (Sedgwick.) German: Major. (Bright.) Latin Seminary. (Warren.) Xenophon. (Spieker.) Elliptic Functions. (Craig.) Calculus. (Franklin.) Hist. of Philos. (G. S. Morris.) Romance Lang.: Adv. (Elliott.) French: Major. (Marcou.)	
M. 12	Greek Seminary. (Gildersleeve.) German: Minor. (Wood.) Romance Lang.: Adv. (Elliott.) Mechanics. (Craig.) Political Economy: Minor. (Ely.) Mammalian Anatomy. (Brooks.) German: Minor. (Bright.)	German: Minor. (Wood.) Romance Lang.: Adv. (Elliott). Lucretius. (Warren.) Mechanics. (Craig.) Philos. of Hist. (G. S. Morris.) Political Economy: Minor. (Ely.)	Greek Seminary. (Gildersleeve.) German: Minor. (Wood.) Philos.: Minor. (G. S. Morris.) Political Economy: Minor. (Ely.) French: Minor. (Marcou.)	Greek Metres. (Gildersleeve.) German: Minor. (Wood.) Romance Lang.: Adv. (Elliott.) Lucretius. (Warren.) Mechanics. (Craig.) Philos.: Minor. (G. S. Morris.) Political Economy: Minor. (Ely.) Mammalian Anatomy. (Brooks.) German: Minor. (Bright.)	German: Minor. (Wood.) Lucretius. (Warren.) Philos.: Minor. (G. S. Morris.) Political Economy: Minor. (Ely.) French: Minor. (Marcou.	History: Adv. (Adams.)
P. M. 1	French: Minor. (Marcou.) Higher Pl. Curves: Elem. (Story.) New Testament Greek. (Harris.)	French: Minor. (Marcou.) Philos.: Minor. (G. S. Morris.)	French: Minor. (Marcou.) Higher Pl. Curves: Elem. (Story.) New Testament Greek. (Harris.)	French: Minor. (Marcou.) Higher Pl. Curves: Elem. (Story.)	French: Minor. (Marcou.)	
2	History: Minor. (Adams.) Drawing. (Newell.) (2.15 p. m.)	History: Minor. (Adams.) Classical History. (Jameson.)	History: Minor. (Adams.) Modern English. (Browne.)	History: Minor. (Adams) Classical History. (Jameson.)	History: Minor. (Adams.) Drawing. (Newell.) (2.15 p. m.) Modern English. (Browne.)	
3	Electr. and Mag. (Rowland.)	Shakspeare. (Wood.) Electr. and Mag. (Rowland.) Middle High German. (Raddatz.)	Electr. and Mag. (Rowland.) German: Major. (Raddatz.)	Physics: Maj. (Hastings.) (3.30 p.m.) Deutsche Stilübungen. (Raddatz.) Second Thursday in each month.	Electr. and Mag. (Rowland.) Middle High German. (Raddatz.)	
4	Finance. (Ely.) English Phonetics. (Wood.)	Substitutions. (Sylvester.) Anglo-Saxon: Adv. (Wood.) Sanskrit: Elem. (Bloomfield.) Old High German. (Bright.)	Finance. (Ely.) Anglo-Saxon: Adv. (Wood.)	Anglo-Saxon: Elem. (Wood.) Compar. Greek Gram. (Bloomfield.)	Substitutions. (Sylvester.) Finance. (Ely.) Anglo-Saxon: Adv. (Wood.) Sanskrit: Elem. (Bloomfield.) Old High German. (Bright.)	
5	Ethics. (G. S. Morris.)	Logic. (Peirce.)	History: Lect. (Adams.)	Logic. (Peirce.)	Institut. Hist. (Adams.) (8 p. m.)	

The public lectures in Hopkins Hall begin at 5 p. m.

December, 1882.

STANDING ANNOUNCEMENTS.

Publications Issued under the Auspices of the Johns Hopkins University.

I.—AMERICAN JOURNAL OF MATHEMATICS.

Professor J. J. Sylvester, F. R. S., D. C. L., Editor. Quarto. Quarterly. Subscription, $5 per year. Vol. i., 1878, 388 pp. Vol. ii., 1879, 408 pp. Vol. iii., 1880, 398 pp. Vol. iv., 1881, 384 pp. Vol. v., 1882.

II.—AMERICAN CHEMICAL JOURNAL.

Professor I. Remsen, M. D., Ph. D., Editor. Octavo. Bi-monthly. Subscription, $3 per year. Vol. i., 1879, 460 pp. Vol. ii., 1880, 448 pp. Vol. iii., 1881, 462 pp. Vol. iv., 1882.

III.—THE AMERICAN JOURNAL OF PHILOLOGY.

Professor B. L. Gildersleeve, Ph. D., LL. D., Editor. Octavo. Quarterly. Subscription, $3 per year. Vol. i., 1880, 585 pp. Vol. ii., 1881, 570 pp. Vol. iii., 1882.

IV.—STUDIES FROM THE BIOLOGICAL LABORATORY.

Including the Chesapeake Zoological Laboratory.

Professor H. N. Martin, M. A., D. Sc., M. D., Editor, and W. K. Brooks, Ph D., Associate Editor. Octavo. Subscription, $5 per volume. Vol. i., 1879-80, 500 pp., 40 plates. Vol. ii., 1881–82.

As a considerable portion of the contents of a volume of the Studies from the Biological Laboratory frequently consists of reprints from the Journal of Physiology, subscribers to the latter will be charged only $3.50 for each volume of the "Studies."

V.—CONTRIBUTIONS TO LOGIC.

Professor C. S. Peirce, Editor. A volume of Logical Contributions, by members of the Johns Hopkins University. (Little, Brown & Co., Boston, 1882).

Contents: The logic of the Epicureans, by Allan Marquand; On the algebra of logic, by Miss Ladd; On the algebra of logic, by O. H. Mitchell; On relative numbers, by B. I. Gilman; On probable inference, by C. S. Peirce.

VI.—HISTORICAL AND POLITICAL STUDIES.

H. B. Adams, Ph. D., Editor. The publication of a series of University Studies in American Institutional History, (with special reference to the local government and economics of individual States of the Atlantic Seaboard and of the Northwest), is now in progress. A list of the earlier numbers of the series will be sent on application. Subscription, $3 per volume of twelve numbers, comprising from 300 to 400 pages.

THE JOURNAL OF PHYSIOLOGY.

Michael Foster, M. D., F. R. S., Cambridge, England, Editor in Chief, Octavo. Six parts will form a volume of about 500 pp. Subscription, $5 per volume. Vol. i., 626 pp., 17 plates. Vol. ii., 596 pp., 18 plates. Vol. iii. in progress.

This journal is published in America with the aid of the Johns Hopkins University, and is issued from the University to subscribers.

The Official Publications of the University are:

I. An Annual Report presented by the President to the Board of Trustees, reviewing the operations of the University during the past academic year.

II. The University Circulars, issued from time to time, giving current information as to the work here in progress or proposed.

III. A Register, giving the list of officers, academic staff, and students, and containing detailed statements as to the regulations and work of the University, published near the close of each academic year.

Announcements of proposed lectures, courses of instruction, etc., appear in the University Circulars, or are separately issued from time to time.

Communications in respect to exchanges and remittances may be sent to the Johns Hopkins University (Publication Agency), Baltimore.

HOPKINS HALL LECTURES.

Notice in Respect to the Admission of the Public.

In answer to inquiries, and in correction of some current misapprehensions, the following statements are made in respect to the courses of lectures annually given in the Johns Hopkins University.

1. These courses are academic lectures, designed primarily for the members of the University, and supplementary to the regular class-room work of the students.

2. As the members of the University rarely require the entire room, the Trustees have taken great pleasure in inviting other persons, not connected with the University, to attend.

3. As these lectures are not intended for popular entertainment, but for the instruction of students, those persons first receive tickets, in most cases, who are known to be especially interested in a particular course,—ladies as well as gentlemen. Preference is thus given, according to the character of the course, to teachers in other institutions, public and private; students of medicine, law, etc.; professional men, and others. If any tickets remain undistributed, they are given out to those who may have applied for them, in order of application.

4. The hall is full when 200 hearers are present; it is uncomfortable if more are admitted. Not infrequently two or three times that number of persons apply for admission and often applications for tickets cannot be granted. To give the lectures elsewhere would alter their character as a part of the ordinary academic work of the University.

5. *There is no general course ticket issued.* Applications should state specifically the course for which tickets are desired. Programmes and other current information pertinent to university work may be found in the *University Circulars*, sent to subscribers on the payment of one dollar per annum, either by Messrs. Cushings & Bailey, Messrs. John Murphy & Co., or the University.

The usage of giving personal notification is not likely to be continued, and those therefore who have been accustomed to receiving such announcements, should hereafter consult the *Circulars.*

6. It will save much delay if applications for tickets and inquiries on these and other routine matters are addressed not to individuals but to the Johns Hopkins University, *by postal card*, and answers will be promptly returned by mail. Personal applications consume time needlessly.

☞ The lectures begin at 5 o'clock *punctually*. The doors of the hall are opened at fifteen minutes before 5, and the lectures do not exceed an hour in the delivery.

Calendar.—Academic Year, 1882-83.

Academic Year Began—Tuesday, September 19.
Instructions Resumed—Tuesday, September 26.
Christmas Recess—Friday, December 22-Tuesday, January 2.
Commemoration Day—Thursday, February 22.
Spring Recess—Thursday, March 22–Tuesday, March 27.
Term of Instruction Closes—Friday, June 8.
Next Academic Year Begins—Tuesday, September 18.
Instructions Resumed—Tuesday, September 25.

Appointments of Societies.

The University societies meet monthly during the academic year, as follows:

Scientific—First Wednesday, 8 p. m.
Philological—First Friday, 12 m.
Metaphysical—Second Tuesday, 8 p. m.
Historical and Political Science—Third Friday, 8 p. m.
Mathematical—Third Wednesday, 8 p. m.
Naturalist's Field Club—As announced.

Maryland Historical Society—Second Monday, 8 p. m.
Maryland Academy of Sciences—First and Third Monday, 8 p. m.

The Seventh Annual Report of the President of the University, issued November 11, 1882, and the University Register, issued June 5, 1882, will be sent on application.

The University Directory, Schedule of Consultation Hours, etc., etc., is printed on pages 19, 20, Circular 19.

The University Circulars, Annual Report, and Register will be sent by mail for one dollar per annum. Price of Volume I. of University Circulars, with index, bound, three dollars.

The Johns Hopkins University Circulars are printed by Messrs. JOHN MURPHY & CO., 182 West Baltimore Street, Baltimore, from whom single copies may be obtained. They may also be procured, as soon as published, from Messrs. CUSHINGS & BAILEY, No. 262 West Baltimore Street, Baltimore.

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JOHNS HOPKINS UNIVERSITY CIRCULARS

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CALENDAR, 1882–83.

Tuesday, September 19.	**Current Academic Year Began.**
Monday, February 12.	**Professor Harrison's Course on Anglo-Saxon Poetry Begins. (See p. 63).**
Tuesday, February 20.	**Professor Hall's Course in Pedagogy Begins. (See p. 63).**
Thursday, February 22.	**Commemoration Day.**
Friday, March 2.	**Meeting of Philological Association, 12 M.**
Monday, March 5.	**Mr. Cable's Course in English Literature Begins. (See p. 63).**
Wednesday, March 7.	**Meeting of Scientific Association, 8 P. M.**
Tuesday, March 13.	**Meeting of Metaphysical Club, 8 P. M.**
Friday, March 16.	**Meeting of Historical and Political Science Association, 8 P. M.**
Wednesday, March 21.	**Meeting of Mathematical Society, 8 P. M.**
Friday, June 8.	**Term of Instruction Closes.**

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MATHEMATICS.

On Dr. F. Franklin's Proof of Euler's Theorem concerning the Form of the Infinite Product $(1-x)(1-x^2)(1-x^3)\ldots$, *by* J. J. SYLVESTER.

[Intended for the deferred meeting of the University Mathematical Society, December 20, 1882].

Revolving in my mind Mr. Franklin's remarkable proof of Euler's theorem concerning the above infinite product inserted in the *Comptes Rendus* of the Institute of France for 1880, I have found it useful to employ a certain terminology to enable myself to seize some of the points which it contains with a firmer grasp and to clothe it in what seems to me a more purely discursive, as distinguished from what, by analogy to geometrical processes, I am wont to call a diagrammatic form of reasoning; thinking that others may find advantage in what has been useful to myself, I avail myself of the pages of the *Circular* to give it publicity.

Let us agree to understand by a *distribution* of n any combination of *unrepeated* integers in descending order, whose sum is equal to n. The number of such component integers may be termed the *order* of the distribution.

If the initial components of such distributions be $m-1, m-2, \ldots, (m-i)$ [where i may be equal to but cannot exceed the order] not followed by an element $m-i-1$, I call i (the number of terms in such initial sequence) the *consecutant* and the final (*i. e.*, the least) component, the *concluant* of the distribution.

Lemma. Any distribution of a given integer which does not form a single sequence whereof the concluant is either equal to or greater by a unit than the consecutant, may be converted by one or the other (but not by either) of two reversible processes (say of loading or unloading) into another distribution in which the order is diminished or increased by a single unit.

By loading is to be understood the process of taking away the concluant (say ω) and increasing the ω first terms of the initial sequence each by a unit; and by unloading, that of taking away a unit from each of the components in the initial sequence and adding on an element equal to the consecutant as the new concluant.

1st. Suppose that the distribution does not form a single sequence.

If the concluant is equal to or less than the consecutant it is obvious that loading will be possible but not unloading, because the latter would give rise to a new concluant equal to or greater than the original one.

On the other hand, if the concluant is greater than the consecutant, unloading will be possible but not loading, because there will be too few terms in the initial sequence to exhaust (by the addition of one unit to each) the number of units in the concluant.

2d. Suppose that the entire distribution forms a single sequence.

If the concluant is *less* than the consecutant loading will still be possible, because the number of terms in the sequence after taking away the concluant will still be not greater than the concluant.

Again, if the concluant is more than a unit greater than the consecutant, unloading will still be possible because the new concluant will be less than the original one even after it has lost a unit by the process of unloading.

Hence the Lemma is proved.

And as a Post-lemma, it may be stated that when the distribution forms a single sequence such that the concluant is equal to or only one unit greater than the consecutant, neither loading nor unloading will be possible. The loading on the first supposition is defeated by the fact that the diminished sequence will be one too few in number to absorb the units which make up the concluant—and the unloading in the second supposition is defeated by the fact that the new concluant will be equal to (*i. e.*, will be a repetition of) the old one when by the act of unloading it is diminished by a unit.

From the lemma and post-lemma combined, it follows as an inference that all the distributions of any number n may be taken in pairs, (consisting of one of an even and one of an odd order) unless it should be the case that one of such distributions is a term in the series

$$1,\ 2,\ 3.2,\ 4.3,\ 5.4.3,\ 6.5.4, \ldots, \overline{2i-1}\ \overline{2i-2}\ldots i,\ 2i.\overline{2i-1}\ldots\overline{i+1}, \ldots$$

which represent distributions of the several integers

$$1,\ 2,\ 5,\ 7,\ 12,\ 15, \ldots \frac{3i^2-i}{2},\ \frac{3i^2+i}{2}, \ldots$$

to which the process either of loading or unloading (contraction or expansion by a unit) is inapplicable.

Hence if we denote by n_o, n_e, the number of distributions of n, into an odd and even number of unrepeated parts, we must have $n_o - n_e = 0$, except when $n = \frac{3i^2 \mp i}{2}$, in which case $n_e - n_o = (-)^i 1$.

Consequently we have $(1-x)(1-x^2)(1-x^3)\ldots$, *i. e.*,

$$1 + \ldots + (n_e - n_o)x^n + \ldots = \sum_{i=+\infty}^{i=-\infty} (-)^i x^{\frac{3i^2+i}{2}},$$

which is Euler's theorem.

To make the demonstration absolutely objection-proof it ought to be shown that if X is convertible into Y by loading or unloading, Y will be convertible into X by the reverse process—but this is almost self-obvious; for if X has become Y by loading, the new consecutant cannot be greater than the old one and will therefore not be greater than the new concluant, but equal to or less than it, and therefore the process of *unloading* is the one applicable to Y, and if X has become Y by unloading, the new consecutant cannot be less than the old one and will therefore be greater than the new concluant, and therefore the process of *loading* is the one applicable to Y; this completes the proof, and leaves I think nothing further to be desired.

In Mr. Durfee's question, treated of in the last number of the *Circulars*, the object of research is the number of self-conjugate partitions (with repeated or unrepeated components) of a given integer n; in Mr. Franklin's, the object sought for is the number (1 or 0) of (so to say celibate or) unconjugate distributions of an integer: the Ferrers-law of conjugation is of universal application to all partitions—the Franklin-law only to partitions with unrepeated components.

There is, however, a singular parallelism between the two theories; let us agree to call the self-conjugate in the one, and the non-conjugate partitions in the other, in each case alike *special* partitions—and denote the number of distributions of n into an odd number and into an even number of *unrestricted* parts by $(n)_o$ and $(n)_e$ respectively. Then just as the difference between n_o and n_e is the number of special partitions in the one, so it may be shown that the difference between $(n)_o$ and $(n)_e$ (which is well known to be same as the total number of partitions of n into unrepeated odd parts) is the number of special partitions in the cognate theory.

By a singular oversight in my note in the last *Circular*, I omitted to state that Mr. Durfee's rule is tantamount to affirming that the number of self-conjugate partitions or (which is the same thing) of symmetrical partition graphs for n is the coefficient of x^n in the series

$$1 + \ldots + \frac{x^{i^2}}{(1-x^2)(1-x^4)\ldots(1-x^{2i})} + \ldots$$

and since this series is identical with the infinite product $(1+x)(1+x^3)(1+x^5)\ldots$ the number of self-conjugate partitions is the number of ways of distributing n into unrepeated odd-integers, a result which can be obtained directly by regarding any symmetrical partition graph as made up of a set of successively diminishing equilateral elbows or say carpenters' rules, each of which necessarily contains an odd number of points: the number of such elbows for any given graph will be the same as the number of points in the side of Mr. Durfee's square nucleus, and consequently we have an intuitive proof of the theorem that the infinite product $(1+ax)(1+ax^3)(1+ax^5)\ldots$ is equal to the infinite series

$$1+\ldots+\frac{x^{i^2}}{(1-x^2)(1-x^4)\ldots(1-x^{2i})}a^i+\ldots$$

because the coefficient of a^ix^n is the same in both expressions. By a similar method I obtain an intuitive and almost instantaneous solution of the problem to expand in infinite series the infinite products which express a Theta Function and its *reciprocal*, and many other questions of a similar nature.

It was the anticipation of the parallelism between the expressions for the number of special partitions in the unrepeated-numbers and the repeated-numbers theories which led me to find *à priori* the partition-into-odd-integers expression for the number of self-conjugate partitions, and thus started me on the track of the graphical method of transforming infinite products into infinite series: the light of analogy may sometimes "lead astray" but it is more often "light from heaven."

On the Use of Cross-Gratings to obtain Certain Developments connected with the Theory of Elliptic Functions, by J. J. SYLVESTER.

[Abstract of a paper read at the University Scientific Association, January 3, 1883].

It will be convenient to regard the components of any partition as arranged in a natural, say a descending order of magnitude: a partition graph means a series of points, say the knots in a web or the intersections of a cross-grating, lying in lines parallel to two fixed lines: the number of points, or lines parallel to one of the boundaries chosen at will, will represent the successive components of the partition and the number of the lines themselves will be the number of parts in the partition.

The lines in question may for greater distinctness be termed *magnitude* lines and the crossing ones, *part* lines. The graph may be termed regular when the magnitude lines never increase as they recede from the rectilinear boundary to which they are parallel. This, we see intuitively, cannot happen without the same condition being true of lines parallel to the *part* boundary: so that we may say that a regular partition graph is one in which the lines and columns of points neither of them ever increase in length as they recede from their respective boundaries. If such a graph corresponds to a partition *without* repetitions, the lines drawn in the magnitude direction must continually contract (*i. e.*, contain fewer and fewer points) as they recede from their maximum boundary.

The correlation referred to in the preceding paragraph is tantamount to saying that if there be two systems of partitions in one of which a given number is set out in every possible way as a sum of i parts none exceeding j in the magnitude, and another in which the same number is set out in every possible way as a sum of j parts none exceeding i in number, such partitions arranged in natural order will have a one-to-one correspondence, being representable by the same regular graphs with the names of the magnitude and part boundaries interchanged, so that there will be the same number of partitions in the two systems.

A partition is self-conjugate when its representative graph, after an interchange of the names of the part- and magnitude-lines, gives the same reading.

Such a graph, therefore, must be symmetrical.

Suppose the number of parts (which will be necessarily the same as the largest part) to be i and the partible number n.

Then its graph may be resolved into i angles fitting into one another, consisting of continually decreasing odd numbers and the number of such graphs will be the number of ways of composing n with unrepeated odd numbers: but it may also be analyzed into a square containing i^2 points and two similar and equal appendages each containing $\frac{n-i^2}{2}$ points; and consequently their number will be the number of ways in which $\frac{n-i^2}{2}$ may be made up with the numbers $1, 2, \ldots i$, or what is the same thing $n-i^2$ with the numbers $2, 4, \ldots 2i$; it is consequently the coefficient of n in the development of

$$\frac{x^{i^2}}{(1-x^2)(1-x^4)\ldots(1-x^{2i})},$$

but it is also by virtue of the preceding remark the coefficient of x^na^j in the continued product $(1+ax)(1+ax^3)(1+ax^5)$. Hence this continued product

$$=1+\frac{x}{1-x^2}a+\frac{x^4}{(1-x^2)(1-x^4)}a^2+\frac{x^9}{(1-x^2)(1-x^4)(1-x^6)}a^3$$
$$+\ldots+\frac{x^{i^2}}{(1-x^2)(1-x^4)\ldots(1-x^{2i})}a^i+\ldots$$

The expansion of the reciprocal of $(1-ax)(1-ax^3)(1-ax^5)\ldots$ may be obtained in a similar manner; the coefficient of x^na^j in this product, is the number of ways in which n can be composed with j free odd numbers. If we construct a graph with j angles or elbows fitting into another such that the number of nodes in each such angle from the outermost inward corresponds with any such partition in descending order, the graph so constructed will be still symmetrical but no longer regular; a line of nodes instead of being necessarily equal or less in number than an antecedent one may jut one degree beyond it, but if the j points in the diagonal be removed (as in the example following, the points

```
1 . . . .
. 2 . . .
. . 3 . . .
. . . 4 .
. . . .
    .
```

whose places are supplied by the numbers 1, 2, 3, 4) then the figure that is left is decomposable into two regular graphs with one boundary line, horizontal or vertical, and the other oblique. Hence the fraction above given expanded in powers of a becomes

$$1+\frac{x}{1-x^2}a+\ldots+\frac{x^i}{(1-x^2)(1-x^4)\ldots(1-x^{2i})}+\ldots$$

the only difference from the preceding case being that i points now instead of i^2 are taken away from the graph.

I might give numerous other exemplifications of the power and grasp of this method, but the following two may suffice for the present. I propose first to prove the equation between the reciprocal of

$$(1-ax)(1-ax^2)(1-ax^3)\ldots,$$

and the infinite series

$$1+\frac{x}{1-x}\cdot\frac{a}{1-ax}+\frac{x^4}{(1-x)(1-x^2)}\cdot\frac{a^2}{(1-ax)(1-ax^2)}+\ldots$$
$$+\frac{x^{i^2}}{(1-x)(1-x^2)\ldots(1-x^i)}\cdot\frac{a^i}{(1-ax)(1-ax^2)\ldots(1-ax^i)}+\ldots$$

The coefficient of x^na^j in the continued product is the number of regular graphs that can be formed with n^2 nodes, containing j lines of them with no limitations to the number of the columns. We may suppose, therefore, the number of columns to be made successively 1, 2, 3, . . . Consider the case where there are i columns; the graph being regular the lines and columns will intersect in i^2 nodes, and there will be left $n-i^2$ nodes to be made up of i quantities none greater than i (viz., the vertical filaments of nodes in the column underlying the squares), and i other quantities not greater than i but otherwise unlimited (viz., the horizontal filaments of nodes in the hollowed out indefinite parallelogram abutting alongside of the square): that number we well know is the coefficient of x^n in $\frac{1}{(1-ax)(1-ax^2)(1-ax^i)}\cdot\frac{1}{(1-x)(1-x^2)(1-x^i)}x^{i^2}$.

Hence for every value of j the coefficient of x^na^j in the infinite product is the coefficient of x^na^j in the infinite series, and consequently the two forms when developed must be identical.

Not to weary my readers I hurry on to the development in an infinite series of the product of the two infinite products

$(1+ax)(1+ax^3)(1+ax^5)\ldots$ and $(1+a^{-1}x)(1+a^{-1}x^3)(1+a^{-1}x^5)\ldots$

Here it will be expedient to explain what I mean by a parallel bipartition of n; it is simply a couple of sets of numbers written on opposite sides of a line of demarcation, so that the number of the numbers on the left always exceeds that on the right by a given difference δ, which may be any number from zero upwards, and such that the sum of all the elements collectively is equal to n.

When this difference is zero, such a bipartition may be called equiparallel, in other cases parallel with a difference δ.

It is then clear that the coefficient of x^na^j or x^na^{-j} in the above product is nothing else but the number of parallel bipartitions of n to the difference j limited to contain only odd numbers which must not appear in the same arrangement more than once on the same side of the line of demarcation.

In particular the coefficient of x^n in the term not containing a will be the number of equi-parallel bipartitions of n restricted to odd numbers not repeated on the same side of the separating line.

Form a graph as follows: Supposing one of the bipartitions to consist of θ parts on each side, say $a, b, c, \ldots l;\ \alpha, \beta, \gamma, \ldots \lambda$; the parts being on each side taken in descending order construct angles or elbows in which the horizontal sides contain $\frac{a+1}{2}, \frac{b+1}{2}, \ldots \frac{l+1}{2}$, and the vertical sides $\frac{\alpha+1}{2}, \frac{\beta+1}{2}, \ldots \frac{\lambda+1}{2}$ points, then these will contain $\frac{a+\alpha}{2}, \frac{b+\beta}{2}, \ldots \frac{l+\lambda}{2}$ points respectively; on filling them into one another we shall obtain a regular graph with θ lines or columns made up of $\frac{n}{2}$ points, and conversely every regular graph of $\frac{n}{2}$ points may be resolved into angles with sides $p, p';\ q, q';\ r, r' \ldots$ corresponding to an equi-parallel unrepeated odd-number bipartition $2p-1,\ 2q-1,\ 2r-1, \ldots;\ 2p'-1,\ 2q'-1,\ 2r'-1, \ldots$

Hence the coefficient of x^n in the term not containing a in the development is the number of regular graphs that can be formed with $\frac{n}{2}$ points and therefore the term not containing a is $\frac{1}{(1-x^2)(1-x^4)(1-x^6)\ldots}$.

Now consider the term containing a^j to which corresponds a parallel bipartition with j more elements to the left than to the right of the separating line: arrange the sets on each side of the line in descending order, strike off the δ highest on the left hand side and construct a graph G with the sets which remain as in the last case; then subtract 1, 8, 5, $(2j-1)$ respectively from each of the δ elements to the left, and place taken in ascending order half the numbers of points remaining, over the top line of the graph G, there will result a regular graph G' and by an obvious reverse process every such graph can be made to correspond with a bipartition of unrepeated odd numbers having δ more numbers to the left than to the right. Hence the number of the parallel bipartitions to the difference δ will be the number of indefinite partitions of $\frac{1}{2}\left\{n-\overline{1+8+\ldots+j}\right\}$ or $\frac{n-j^2}{2}$, *i. e.*, the coefficient of x^n in $\frac{x^{j^2}}{(1-x^2)(1-x^4)(1-x^6)\ldots}$.

Hence the given bi-product when developed must be identical with

$$\frac{1}{(1-x^2)(1-x^4)\ldots}\left\{1+x(a+a^{-1}) \right.$$
$$\left. +x^4(a^2+a^{-2})+x^9(a^3+a^{-3})+h\right\}.$$

In the preceding volume of the *Circular* I showed how the self-same method of points (but very differently applied) serves to establish and leads to wide generalizations of the theorem of Jacobi, upon which depends the proof of the impossibility of the existence of 8-period functions.

In a future number of the *Circular*, or else in the *American Journal of Mathematics*, I propose to show how to obtain intuitively by a graphical construction the expression for the product of the two infinite products

$$\frac{1-a^k}{1-a}\cdot\frac{1-a^{3k}}{1-a^3}\cdot\frac{1-a^{5k}}{1-a^5}\ldots \text{ and } \frac{1-a^{-k}}{1-a^{-1}}\cdot\frac{1-a^{-3k}}{1-a^{-3}}\cdot\frac{1-a^{-5k}}{1-a^{-5}}\ldots$$

The *true inwardness* of this powerful analytical method depends in the first place on the idea of *correspondence*, assisted in the second place (in some but not in all instances) by the idea of graphical representation of partition numbers restrained to assume a natural order of succession.

Mr. Ferrers' method, which has lain so long dormant and sterile in mathematical soil, has after an interval of 80 years begun to germinate, and seems to be about to burst forth into luxuriant growth and efflorescence.

It is Mr. Durfee's graphical determination of the number of self conjugate partitions of n, inserted in a preceding *Circular*, that has let in the light and air and supplied the fertilizing influence needful to bring this about.

On the Number of Fractions in their Lowest Terms whose Numerators and Denominators are Limited not to Exceed a Certain Number, by J. J. SYLVESTER.

[Abstract of a paper read at the University Mathematical Society, January 17, 1883].

The fractions for greater simplicity may be supposed to be proper fractions, except that it is expedient to count in $\frac{1}{1}$ as one of them. To any given limit or argument as it may be called, n corresponds a finite system of fractions in their lowest terms, which may be arranged in order of magnitude; when so arranged the system will be found to possess some remarkable properties, first apparently noticed by Mr. Farey, an English mathematician, in 1816, subsequently made the subject of a proof by Cauchy in the same year, (reproduced in his *Exercises de Mathématiques*, t. 1, 1826), and again demonstrated and extended by Mr. J. W. L. Glaisher in an interesting paper in the *London and Edinburgh Philosophical Magazine* for 1879, the same journal in which the subject was first broached.

I am under the impression that I have seen somewhere the names of one, if not two, English mathematicians who have endeavored to obtain an empirical law for the number of fractions corresponding to any given limit, but all my endeavors to come upon the traces of those investigations, if such exist, have hitherto proved fruitless. Had anything been done in this direction prior to 1879, there is little doubt that reference would have been made to it by Mr. Glaisher, who goes carefully in his paper of that date into the bibliography of the subject.[*]

This number for the limit or argument j is obviously no other than the sum of the *totients* of all the numbers from unit up to j. I shall use Tx to denote the sum of all the totients of all the integers not exceeding x, where x is any positive quantity whatever, and show how to make Tx the subject of a functional equation, from which limiting functions to its value may be deduced. To this end consider the two sets of terms $1, 2, 3, \ldots i$ and $i+1, i+2, \ldots j$, where $j=2i$ or $2i+1$ indifferently.

The number of times that an integer r is contained in any given set of quantities, or rather the number of quantities in the set which contain r, I call the *frequency* of r in respect to the set.

Looking to the two sets here in question it is easily seen that the frequency of any integer *quâ* the second set must either be equal to its frequency *quâ* the first set or exceed it by a single unit. The equi-frequent and unequi-frequent integers are determinable by the following theorem which I call the theorem of harmonic division.

Let j_μ in general denote the integer part of j/μ if it is a fraction, or the whole of it if it is an integer.

Write down the successive ranges

$$j, j-1, j-2, \ldots j_2+1;\ j_2, j_2-1, \ldots j_3+1;$$
$$j_3, j_3-1, \ldots, j_4+1;\ j_4, j_4-1, \ldots, j_5+1 \ldots$$

where it will be understood that if $j_k = j_{k+1}$, the range $j_k \ldots$ becomes abortive.

Any number which appears in the first, third, fifth ... range is equi-frequent and any number which appears in the second, fourth ... range is unequi-frequent in respect to the two given series $1, 2, \ldots i;\ i+1, i+2, \ldots j$.

This theorem will be found to be demonstrable without the slightest difficulty.

The second theorem required is one of which a demonstration almost instantaneous and conclusive is given in the Excursus on Rational Fractions and Partitions, (*Am. Jour. of Math.*, *Vol. V*, *No.* 2), viz., that the sum of the products formed by multiplying the frequency of any integer in respect to a given set of quantities by its totient is equal to the sum of the quantities contained in the set.

This proposition shows that if $fr, f'r$ be the frequencies of r in respect to the two last named sets and τr its totient

$$\sum_{r=1}^{r=\infty}(f'r-fr)\tau r = (1+2+\ldots+j)-2(1+2+\ldots+i),$$

---

[*] Mr. Glaisher, however, takes no notice of M. Halphen's important extension of Farey's theory, published in the Proceedings of the Mathematical Society of France, and followed by another on the same subject by M. Lucas, nor of Herzer's table in 1864, nor Hrabak's, 1876.

and the theorem of harmonic division shows that the left hand side of this equation is equal to

$$\sum_{\lambda=j_2+1}^{\lambda=j}\tau\lambda+\sum_{\lambda=j_4+1}^{\lambda=j_3}\tau\lambda+\sum_{\lambda=j_6+1}^{\lambda=j_5}\tau\lambda+\ldots$$

because $f'r-fr=1$ for the odd-ordered, and $=0$ for the even-ordered harmonic ranges.

The separate sums above written are obviously the same respectively as

$$T_j-T\frac{j}{2},\ T\frac{j}{3}-T\frac{j}{4},\ T\frac{j}{5}-T\frac{j}{6},\ldots$$

Hence, if we write

$$\vartheta_j=T_j-T\frac{j}{2}+T\frac{j}{3}-T\frac{j}{4}+T\frac{j}{5}\ldots\textit{ ad inf.}$$

when j is even integer

$$\vartheta_j=(1+2+\ldots+2i)-2(1+2+\ldots+i)=i^2=\frac{j^2}{4},$$

and when j is an odd integer

$$\vartheta_j=(1+2+\ldots+\overline{2i+1})-2(1+2+\ldots+i)=(i+1)^2=\frac{(j+1)^2}{4}.$$

If now we write for any positive quantity x,

$$\vartheta x=Tx-T\frac{x}{2}+T\frac{x}{3}-T\frac{x}{4}+\ldots,$$

it may be shown by aid of the above results that for all values of x not less than unity,

$$\vartheta x=\text{or}>\frac{x^2}{4}-\frac{x}{2},\qquad \vartheta x=\text{or}<\frac{x^2}{4}+\frac{x}{2}+\frac{1}{4},$$

and from these two inequalities limiting values to $T(x)$ may be deduced by a process of successive approximation in principle the same as that employed by me in the *Am. Jour. of Math.*, *Vol. V*, *No.* 2, *pp.* 124, 125, in connexion with Tchebycheff's theory, but differing from it considerably in the mode of application and in the character of the results to which it leads.

The subject has been for so very short a time studied by me that I feel it desirable to reserve this part of its development for a future communication, but I am in a position to state that it is possible to find superior and inferior limits to Tx, say Lx and Λx, such that Lx shall be of the form Mx^2+Nx+ a rational integral function of log. x and Λx of a similar form, $M'x^2+N'x+$ another rational integral function of x, where M, M' differ by a quantity less than any quantity that may be assigned from one another and from a number λ found from the equation $\lambda(1-\frac{1}{4}+\frac{1}{9}-\frac{1}{16}+\frac{1}{25}\ldots)=\frac{1}{4}$, *i. e*, equal to $3/\pi^2$.

Accordingly the ultimate, or so to say asymptotic, value of $\frac{Tx}{x^2}$ is $3/\pi^2$ where Tx is the number of pairs of integers not exceeding x, which are relatively prime to each other; consequently since the total number of such pairs is ultimately in a ratio of equality to $\frac{x^2+x}{2}$, it will follow, if the above assertion is correct, that the chance of two arbitrary independent integers, being relatively prime to one another, is $\frac{6}{\pi^2}$; the odds in favor of two such numbers being relatively prime, are thus very nearly expressed by the ratio of 60792 to 39268; that is to say, are pretty nearly as 76 to 49 or a trifle better than 3 to 2.

In what precedes I have used the simplest means or formula sufficient for obtaining a functional equation to the sum-totient Tx, but the theorem of harmonic division admits of a very wide generalization, and accordingly the functional equation admits of an indefinite number of distinct presentations.

Thus instead of j belonging to the series $2i$, $2i+1$ it may be considered as belonging to the series ki, $ki+1,\ldots,ki+(k-1)$, and the theorem of harmonic division then is as follows: calling the ranges commencing with $\left(\frac{j}{\lambda}\right)$ and ending with $\left(\frac{j}{\lambda+1}\right)+1$, range number λ where λ may be understood to be any integer from 0 upwards (0 itself included) if the residue of λ in respect to k is μ and if $f'r$, and fr are the frequencies of r in respect to the two series $1, 2, \ldots j$, $1, 2, \ldots i$, then when r belongs to the range whose number is λ and the residue of λ in respect to k is (λ) it will be found that $f'r-kfr=(\lambda)$.

By way of example suppose $k=3$, then writing

$$\vartheta j=\left(Tj+T\frac{j}{2}-2T\frac{j}{3}\right)+\left(T\frac{j}{4}+T\frac{j}{5}-2T\frac{j}{6}\right)+\ldots$$

it may readily be proved that according as $j=3i$, or $3i+1$, or $3i+2$, ϑj will equal $3i^2$, or $3i^2+3i+1$, or $3i^2+6i+3$, and similarly if

$$\vartheta j=(\vartheta j+\vartheta\frac{j}{2}\ldots+\vartheta\frac{j}{k-1}-k\vartheta\frac{j}{k})+(\vartheta\frac{j}{k+1}\ldots+\vartheta\frac{j}{2k-1}-k\vartheta\frac{j}{2k})+\ldots$$

then ϑj according as $j=ki$, or $ki+1,\ldots$ or $ki+(k-1)$ will have k distinct and perfectly determinate values of which the first will be $\frac{k-1}{2k}j^2$ and the last $\frac{k-1}{2k}(j+1)^2$.

More general formulae still may be obtained by supposing $j=ki+r$, $j'=k'i+r'$, where k, k' are relative prime numbers and r, r' less than k, k' respectively.

Let $P=kk'i+R$, R being less than kk' and congruent to r in respect to modulus k and to r' in respect to modulus, then if we divide P into harmonic ranges and call fr, $f'r$ the frequencies of r in respect to the two series $1, 2, \ldots j$; $1, 2, \ldots j'$, and call ν the number of the range to which r belongs, and δ, δ' the residues of ν in respect to kk' respectively, it will be found that $kf'r-k'fr=\delta'-\delta$.

Take as an example $i=20$, $j=41$, $j'=62$, so that $k=2$, $k'=3$, then $P=125$ and for

$$\begin{aligned}\nu&=0,1,2,3,4,5,\\ \delta&=0,1,0,1,0,1,\\ \delta'&=0,1,2,0,1,2,\\ \delta'-\delta&=0,0,2,\bar{1},1,1,\end{aligned}$$

the harmonic ranges of P beginning with Range No. 2 will be seen to be 125 — 63, 62 — 42, 41 — 32, 31 — 24, 23 — 21, 20 — 18, 17 — 16, 15 — 14, 13, etc., and the corresponding frequencies of the numbers in those ranges in regard to the series 1, 2, ... 41, 1, 2, ... 62, will be seen to be

1, 0; 1, 1; 2, 1; 2, 1; 3, 2; 3, 2; 4, 2; 4, 3; ... respectively,

and we have $2.1-3.0=2$, $2.1-3.1=\bar{1}$, $2.2-3.1=1$, $2.2-3.1=1$, $2.3-3.2=0$, $2.3-3.2=0$, $2.4-3.2=2$, $2.4-3.3=\bar{1}\ldots$, in which the recurring period is as it ought to be, $2, \bar{1}, 1, 1, 0, 0$.

By means of this division a still wider latitude could be won were it worth while, for the expression of the functional equation to the sum-totient. Another statement and further extensions of the theory are contained in a Note intended for publication in the *Comptes Rendus* of the Institute of France. I may add that I have had a table constructed of the value of Tx for all values of x up to 500 inclusive, and that Tx is always intermediate within this range between $3/\pi^2\,x^2$ and $3/\pi^2\,(x+1)^2$ —a very noteworthy result: and which I have little doubt remains true for all values of x.

On Subinvariants, by J. J. SYLVESTER.

Professor Sylvester's memoir is continued in the last number (*Vol. V*, *No.* 2) of the *American Journal of Mathematics*.

Section 3, On the Algebraical Deduction of the Ground-forms of the Quintic, is completed from the last number. Section 4 treats of Perpetuants, the name given by the author to absolutely irreducible subinvariants. Next follows an *Excursus* on Rational Fractions and Partitions which contains in an improved and more complete form the author's theory on Simple Denumeration originally given to the world in the year 1855.

At page 123 will be found stated an analytical expression for the function whose residue is the generating function to any such denumerant. As mentioned in a footnote to that page it is a sum of terms whose number is the sum of the totients of all the numbers up to a given limit. This number may be called a sum-totient and to one unit *près* is identical with the number of entries in a complete table of unequal vulgar fractions whose numerators and denominators do not exceed a given number; such tables have been published with the values in decimals or their logarithms annexed, by the late Mr. Goodwyn in 1818 and by Sir George Airy "some years ago"*; the theory of the *sum-totient* forms the subject of a communication to the Mathematical Society of the University of which an account is given in the present number of the *Circular*. The *Excursus* also contains an incidental discussion of Jacobi's theory of the relation between the ascending and descending developments of an Algebraical Fraction.

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* See *Phil. Mag.*, September, 1871. The table therein referred to as having been introduced "some years ago" to the Institution of Civil Engineers in London during a discussion on driving wheels and published in the selected papers of their transactions, is not mentioned in Mr. Glaisher's Report on Tables included in the British Association "Report, 1873," alongside of his mention of Goodwyn's tables. Hence it seems safe to infer (knowing Mr. Glaisher's character for exhaustiveness) that Sir George's table had not been published at that date. This, however, is not decisive, inasmuch as in Mr. Glaisher's paper on "A Property of Vulgar Fractions," in the *Phil. Mag.* for 1879, his bibliography of the subject contains no reference to this table. *En revanche*, the author of the table makes no reference either to Mr. Glaisher or to Mr. Goodwyn, nor does he say a word of the remarkable property of such tables first observed by a Mr. Farey, and subsequently demonstrated by Cauchy, which perfectly explains *à priori* the so-called "Systematic Interruption" which Sir George appears to have become acquainted with, solely from observation.

Proof of a well-known Development of a Continued Product in a Series, by J. J. SYLVESTER.

[Abstract of a paper read at the University Mathematical Society, January 17, 1883].

To prove that the general term in the development in a series of powers of a of the reciprocal of $(1-a)(1-ax)\ldots(1-ax^i)$ (say of Fx) is $(1-x^{j+1})(1-x^{j+2})\ldots(1-x^{j+i}) \div (1-x)(1-x^2)\ldots(1-x).a_j$ say $J_x a^j$, I proceed as follows.

I call the coefficient of a^j in the development X_j, and show that every linear factor of X_j is contained in J_x.

Any such factor, say $(x-\rho_j)$, is a primitive factor of x^r-1, where r is any integer such that $E\frac{i+j}{r} - E\frac{i}{r} - E\frac{j}{r} = 1$ and it is unrepeated.

Let $x=\rho$, and let the negative minimum residue of $i-1$ in respect to r be $-\delta$.

Then $F\rho$ is equal to the product of δ linear functions of a divided by a power of $(1-ar)$, and consequently the only powers of a (say a^θ) which appear in its development will be those for which the residue of θ in respect to r, is $0, 1, 2, \ldots \delta$, and consequently $E\frac{i+\theta}{r} - E\frac{i}{r} - E\frac{\theta}{r} = 0$.

Hence a^j will not appear therein: so that X_j vanishes when any factor of J_x is zero, and consequently since every such factor is unrepeated X_j contains J_x.

But J_x is obviously of the degree ij in x, and X_j which is the sum of the j-ary homogenous products of $1, x, x^2, \ldots, x^i$ is of the same degree. Hence the two functions of x can only differ by a constant factor. On making $x=1$, Fx becomes $(x-a)^{-i}$; so that X_j becomes

$$\frac{(j+1)(j+2)\ldots(j+i)}{2\ldots i}$$

and J_x becomes the product of vanishing fractions

$$\frac{1-x^{j+1}}{1-x}, \frac{1-x^{j+2}}{1-x^2}, \ldots \frac{1-x^{j+i}}{1-x^i}, \text{ i. e., } (j+1), \frac{j+2}{2}, \ldots \frac{j+i}{i}.$$

Hence $X_j = J_x$. Q. E. D.

The expansion of $(1-ax)(1-ax^2)\ldots(1-ax^i)$ in terms of powers of a may be verified in like manner.

It is not without interest to observe (if the remark has not been made before) how this development is connected by the principle of correspondence with the preceding one.

Throwing out by multiplication the factor $(1-a)$ in the denominator of Fx we obtain the reciprocal of $(1-ax)(1-ax^2)\ldots(1-ax^i)$, say $\frac{1}{Gx}$ under the form

$$1+\ldots+\frac{(1-x^{j+1})(1-x^{j+2})\ldots(1-x^{j+i-1})}{(1-x).(1-x^2)\ldots(1-x^{i-1})}x^j a^j+\ldots$$

Consequently the number of ways in which n can be divided into exactly j parts $1, 2, \ldots i$ (repetitions admissible) is the coefficient of x^n in the expansion according to ascending powers in x of the above multiplier of a^j.

But if any such partition be arranged in ascending order, and $0, 1, 2, \ldots (j-1)$ be added (each to each) to its components, it is converted into a partition without repetitions, and by a converse process of subtraction each such partition is convertible into one of the former, but in which either repetition or non-repetition is allowable. Hence the unrepetitional partitions of $n-\frac{j^2-j}{2}$ into j parts limited not to exceed $i-j+1$, have a one-to-one correspondence with the free partitions of n into j parts limited not to exceed i, and must be equal to them in number. Hence the coefficient of a^j in $G(-x)$ may be deduced from that of a^j in $(Gx)^{-1}$ by multiplying the latter by $x^{\frac{1}{2}(j^2-j)}$ and changing i into $i-j+1$. Hence the general term in $G(-x)$ will be

$$\frac{(1-x^{j+1})(1-x^{j+2})\ldots(1-x^i)}{(1-x)(1-x^2)\ldots(1-x^{i-1})}x^{\frac{i^2+1}{2}}a^j \text{ which is right.}$$

When $i=\infty$ each of these developments (like a multitude of others, including the Theta-functions) may be obtained intuitively by the graphical method of points given in my communication to the Johns Hopkins Scientific Association at its last meeting; it remains a desideratum to apply the same method to the above two developments, or either of them, for the case of i.*

In the Ferrers, Franklin, Durfee-Sylvester and other conjugate systems of partitions, the partible number is the same for the corresponding partitions; in this last example, (and the like will be shown to be the use in the graphical development of the Theta-function, and its generalizations), the one-to-one correspondence is between partitions of two different numbers.

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* Not so — the result derived springs from the immediate application of a general logical principle as will hereafter be shown.

Erratum, by J. J. SYLVESTER.

In the article headed A Word on Nonions in the *Circular*, *No.* 17, p. 242, near the middle of the page, for the words *Those forms can be derived from an algebra given by Mr. Charles S. Peirce*, (*Logic of Relatives*, 1870), read *Mr. C. S. Peirce informs me that these forms can be derived from his Logic of Relatives*, 1870. I know nothing whatever of the fact of my own personal knowledge.* I have not read the paper referred to, and am not acquainted with its contents. The mistake originated in my having left instructions for Mr. Peirce to be invited to supply in my final copy for the press, such reference as he might think called for. He will be doing a service to Algebra by showing in these columns how he derives my forms from his logic.† The application of Algebra to Logic is now an old tale —the application of Logic to Algebra marks a far more advanced stadium in the evolution of the human intellect; the same may be said as regards the application by Descartes of Analysis to Geometry, and the reverse application by Eisenstein, Dirichlet, Cauchy, Riemann, and others, of Geometry to Analysis—so that if Mr. Peirce accomplishes the task proposed to him, (his ability to do which I do not call into question), he will have raised himself as far above the level of the ordinary Algebraic logicians as Riemann's mathematical stand-point tops that of Descartes.

It is but justice to Boole's memory to recall the fact that, in one of his papers in the Philosophical Transactions, he has made a reverse use of logic to establish a certain theorem concerning inequalities, which is very far from obvious, and which I think he states it took him ten years to deduce from purely algebraical considerations, having previously seen it through logical spectacles — I mean, by the aids to vision afforded him by his logical calculus: this theorem I believe (or at least did so when it was present to my mind) must of necessity admit of a much more comprehensive form of statement.

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* I have also a great repugnance to being made to speak of Algebras in the plural: I would as lief acknowledge a plurality of Gods as of Algebras.

† I had understood Mr. Peirce to say that these forms were actually contained in his memoir.

On the Non-Euclidean Geometry, by W. E. STORY.

[Abstract of an article in the American Journal of Mathematics, Vol. V, No. 2].

The non-Euclidean Geometry may be considered from either of two points of view; its peculiarities may be regarded as due to a constant curvature of space (distance being measured in the ordinary way), or to the use of a peculiar kind of measurement (Professor Cayley's "projective" measurement). It is from the latter standpoint, which offers some decided analytical advantages over the other, that the subject is here considered. Professor Klein has generalized the definitions of the projective distances between two points and between two planes; in this paper analogous definitions are given for the distances between a point and a plane, a point and a line, a plane and a line, and two straight lines, and the conditions for parallelism and perpendicularity are established. We speak of points, planes and straight lines as geometrical "elements" of different species, and describe the mutual relation of two coincident points, two coincident planes, a plane and a point in it, a straight line and a point in it, a plane and a straight line in it, or two intersecting straight lines, as a "coincidence," or say that "one element lies in the other;" then it is proved that, with the definitions of distance here given, the minimum distance between an element of a given species on a given element and an element of a given species on a second given element is proportional (when not 0) to the distance between the given elements. The idea of length, exemplified in the length of a curved line, is extended to the "course" of a continuously moving plane or straight line. The non-Euclidean area of a surface and volume of a solid is defined, and expressions for the circumference and area of a circle of given radius, and the surface and volume of a sphere of given radius, are obtained. It is shown that a sphere of quasi-infinite radius fills all space and has for its surface two coincident planes: a great circle of this sphere then consists of two coincident straight lines. These considerations lead to the determination of the length of the whole straight line, the circumference and area of the whole plane, and the surface and volume of all space. The area of a spherical triangle is obtained as a multiple of its "spherical excess," the multiplier being the square of the sine of a constant multiple of the radius of the sphere. The area of a plane conic is also obtained as a complete elliptic integral of the third kind in Jacobi's form $\Pi(u, a)$. The formulae of the non-Euclidean spherical trigonometry are shown to be deducible from those of the ordinary spherical trigonometry by replacing each angle by a constant multiple of that angle, and each side by a constant multiple of that side divided by the sine of a constant multiple of the radius of the sphere.

On the Numbers $a_{n,m}$, which occur in connection with the Proof of Staudt's Theorem concerning Bernoulli's Numbers, by G. S. ELY.

[Read at a meeting of the University Mathematical Society, January 17, 1883].

These numbers, generally known as $\Delta^n 0^m$, are defined as follows:

$$a_{n,m} = m^n - m(m-1)^n + \frac{m(m-1)}{2}(m-2)^n - \ldots + (-)^{m-1} m 1^n \qquad (1)$$

and the following properties of the numbers are known,

$$\begin{array}{lll} m > n & a_{n,m} = 0, & (2) \\ m = n & a_{n,m} = m\,! & (3) \\ m > n & a_{n,m} \equiv 0 \ (\text{mod. } m\,!) & (4) \\ & a_{n,m} = m a_{n-1,m-1} + m a_{n-1,m}. & (5) \end{array}$$

Now expanding $\frac{1}{ce^x+1}$ by Maclaurin's formula we may write

$$\frac{1}{ce^x+1} = \frac{1}{c+1} + c\frac{d}{dc}\frac{1}{c+1} \,.\, x + \left(c\frac{d}{dc}\right)^2 \frac{1}{c+1} \,.\, \frac{x^2}{2\,!} + \text{etc.}, \qquad (6)$$

in which it is to be noticed that $\left(c\frac{d}{dc}\right)^n$ is not $c^n\frac{d^n}{dc^n}$, but $c\frac{d}{dc}$ repeated n times. The numerical coefficients in the expansion of $\left(c\frac{d}{dc}\right)^n \frac{1}{c+1}$ are recognized as the numbers $a_{n,m}$ by the property (5). But making $c = 1$, we have

$$\frac{1}{e^x+1} = \frac{1}{2} - (2^2-1)B_1\frac{x}{2\,!} + (2^4-1)B_3\frac{x^3}{4\,!} - \text{etc.} \qquad (7)$$

Therefore

$$\begin{aligned} B_{2n-1} &= (-)^n \frac{2n}{2^{2n}-1}\left(c\frac{d}{dc}\right)^{2n-1}_{c=1}\frac{1}{c+1} \\ &= (-)^{n-1}\frac{2n}{2^{2n}(2^{2n}-1)}\Big(a_{2n-1,1}2^{2n-2} - a_{2n-1,2}2^{2n-3} \\ &\qquad + \ldots + (-)^{2n} a_{2n-1,2n-1}\Big). \qquad (8) \end{aligned}$$

Some properties of the numbers $a_{n,m}$ may be noticed.

I Since the right hand member of (7) contains no even powers of x (x^0 excepted) we have necessarily

$$\left(c\frac{d}{dc}\right)^{2n}_{c=1}\frac{1}{c+1} = 0, \text{ or expanding}$$

$$a_{2n,1}2^{2n-1} - a_{2n,2}2^{2n-2} + a_{2n,3}2^{2n-3} - a_{2n,4}2^{2n-4} + \ldots - a_{2n,2n} = 0. \qquad (9)$$

Thus $n = 3$,

$$1\,.\,2^5 - 62\,.\,2^4 + 540\,.\,2^3 - 1560\,.\,2^2 + 1800\,.\,2 - 720 = 0.$$

II. $$\sum_{i=1}^{i=\infty} a_{n,2i-1} - \sum_{i=1}^{i=\infty} a_{n,2i} = (-1)^{n+1} \qquad (10)$$

For example $n = 5$

$$1 - 30 + 150 - 240 + 120 = 1.$$

That this is true generally may be proved as follows:

Assume that

$$\sum_{i=1}^{i=\infty} a_{n-1,2i-1} - \sum_{i=1}^{i=\infty} a_{n-1,2i} = (-1)^n,$$

then by formula (5)

$$a_{n,1} + a_{n,3} + a_{n,5} + \text{etc.} = a_{n-1,1} + 3a_{n-1,2} + 3a_{n-1,3} + 5a_{n-1,4} + \text{etc.},$$

$$a_{n,2} + a_{n,4} + a_{n,6} + \text{etc.} = 2a_{n-1,1} + 2a_{n-1,2} + 4a_{n-1,3} + 4a_{n-1,4} + \text{etc.}$$

$$\therefore \sum_{i=1}^{i=\infty}(a_{n,2i-1} - a_{n,2i}) = -\sum_{i=1}^{i=\infty} a = (a_{n-1,2i-1} - a_{n-1,2i}).$$

Therefore if (10) is true for $n-1$, it is true for n, etc.

III. If n is odd

$$\sum_{i=1}^{i=\infty} a_{n,3i-1} = \sum_{i=1}^{i=\infty} a_{n,3i}. \qquad (11)$$

Thus $n = 7$,

$$a_{7,2} + a_{7,5} = a_{7,3} + a_{7,6}, \qquad i.\ e.$$
$$126 + 16800 = 1806 + 15120.$$

The general truth of formula (11) follows from making $c = \rho = \varepsilon^{\frac{2\pi i}{3}}$ in formula (6). For substituting $x + \frac{2\pi i}{3}$ for x in (7) it is readily seen that the coefficient of x^{2n+1} in the expansion of $\frac{1}{\varepsilon^{x+\frac{2\pi i}{3}}+1}$ is real. But in the expansion of $\frac{1}{\rho e^x+1}$ in terms of the numbers $a_{n,m}$

$$\sum_{i=1}^{i=\infty} a_{2n+1,3i-1} \text{ occurs as the coefficient of } \rho^2 \text{ and}$$
$$\sum_{i=1}^{i=\infty} a_{2n+1,3i} \quad \text{"} \quad \text{"} \quad \text{"} \quad \rho.$$

Hence that the coefficient of x^{2n+1} may be real it is necessary that these expressions should be equal.

IV. $$2\sum_{i=1}^{i=\infty} a_{2n,3i-2} = \sum_{i=1}^{i=\infty}(a_{2n,3i-1} + a_{2n,3i}). \qquad (12)$$

Thus $n = 3$,

$$2(a_{6,1} + a_{6,4}) = a_{6,2} + a_{6,3} + a_{6,5} + a_{6,6}, \qquad i.\ e.$$
$$2(1 + 1566) = 62 + 540 + 1800 + 720.$$

This follows from the expansion which has been given of $\frac{1}{c\varepsilon^x+1}$ by making c equal to ρ and ρ^2 successively where ρ and ρ^2 are the imaginary cube roots of unity. Adding the two expressions thus obtained the coefficient of x^{2n} is found to be

$$2\sum_{i=1}^{i=\infty} a_{2n,3i-2} - \sum_{i=1}^{i=\infty}(a_{2n,3i-1} + a_{2n,3i}). \qquad (13)$$

But

$$\frac{1}{\rho\varepsilon^x+1} + \frac{1}{\rho^2\varepsilon^x+1} = \frac{3}{\varepsilon^{3x}+1} - \frac{1}{\varepsilon^x+1}$$
$$= 1 - (2^2-1)(3^2-1)B_1\frac{x}{2\,!} + (2^4-1)(3^4-1)B_3\frac{x^3}{4\,!} - \text{etc.},$$

and the coefficient of $x^{2n} (n > 0)$ is zero.

This establishes the truth of (12).

V. Let $\frac{1}{\varepsilon^x-1} = u$. Then by successive differentiations we find that

$$\frac{d^{n-1}u}{dx^{n-1}} = (-)^{n-1}\left\{g_{n,1}u + g_{n,2}u^2 + g_{n,3}u^3 + \ldots + g_{n,n}u^n\right\} \qquad (14)$$

in which

$$\begin{array}{llllcllll} g_{1,1} & & & & = & 1, & & & \\ g_{2,1} & g_{2,2} & & & = & 1 & 1, & & \\ g_{3,1} & g_{3,2} & g_{3,3} & & = & 1 & 3 & 2, & \\ g_{4,1} & g_{4,2} & g_{4,3} & g_{4,4} & = & 1 & 7 & 12 & 6, \\ & \text{etc.,} & & & & & \text{etc.,} & & \end{array}$$

and it is evident from the laws of differentiation that the equation among the g's is

$$g_{n,m} = m g_{n-1,m} + (m-1) g_{n-1,m-1}.$$

It is then evident from (5) that

$$m g_{n,m} = a_{n,m}, \text{ or}$$
$$g_{n,m} = a_{n-1,m-1} + a_{n-1,m}.$$

Now it is well-known (vide *Boole, Fin. Diff.*, p. 97) that

$$u^2 = -\left(\frac{d}{dx}+1\right)u,$$
$$2!\,u^3 = \left(\frac{d}{dx}+2\right)\left(\frac{d}{dx}+1\right)u,$$
$$3!\,u^4 = -\left(\frac{d}{dx}+3\right)\left(\frac{d}{dx}+2\right)\left(\frac{d}{dx}+1\right)u.$$
$$\text{etc.} \qquad\qquad \text{etc.}$$

The solution of this set of equations for $\frac{d^n u}{dx^n}$ is given by (14).

The same solution,—with a change of alternate signs,—holds for the successive differential coefficients of $\frac{1}{\varepsilon^x+1}$.

We see therefore that if we have the two series of symbolic equations

$$\begin{array}{ll} (A+1) = 2x_1, & (A-1) = 2y_1, \\ (A+1)(A+2) = 3!\,x_2, & (A-1)(A-2) = 3!\,y_2, \\ (A+1)(A+2)(A+3) = 4!\,x_3, & (A-1)(A-2)(A-3) = 4!\,y_3, \\ \text{etc.,} & \text{etc.,} \end{array}$$

where, after expansion A_k an actual quantity is to be substituted for A^k a representative quantity, and solve them for A_k, we obtain in the first case

$$A_k = a_{k+1,k+1}x_k - a_{k+1,k}x_{k-1} + \ldots + (-)^k a_{k+1,1},$$

and in the second case

$$A_k = a_{k+1,k+1}y_k + a_{k+1,k}y_{k-1} + \ldots + a_{k+1,1}.$$

This solution may be used to obtain some relations among the numbers $a_{n,m}$. Thus, in a paper on Generic Equations (*Quart. Jour.*, Vol. IV), Blissard gives the two symbolic equations,

$$P(P-1)(P-2)\ldots(P-n+1) = (-)^n\frac{n!}{n+1},$$
$$P(P+1)(P+2)\ldots(P+n-1) = -\frac{n!}{n+1},$$

where after expansion P^n becomes P_n and $P_n = (-)^{n-1}B_{n-1}$.

By giving n successive values, knowing that $P_1 = -\frac{1}{2}$, and solving the above equations and substituting B's for P's we find

$$B_{2n-1} = \sum_{i=1}^{i=\infty}(-)^{n+i-1}\frac{a_{2n,i}}{i+1},$$

and

$$B_{2n-1} = \sum_{i=1}^{i=\infty}(-)^{n+i}\frac{a_{2n,i}}{i(i+1)}.$$

Now $P_{2n+1} = 0$ $(n>0)$ therefore solving the above equations for P_{2n+1} we find

$$\sum_{i=1}^{i=\infty}(-)^i\frac{a_{2n+1,i}}{i+1} = 0,$$

and

$$\sum_{i=1}^{i=\infty}(-)^i\frac{a_{2n+1,i}}{i(i+1)} = 0,$$

where in each case $n > 0$.

On Polygons of Maximum Area Inscribed in a Plane Curve, by ARTHUR S. HATHAWAY.

[Abstract of a paper read at the University Mathematical Society, January 17, 1883].

A condition that the area of a polygon whose vertices lie within prescribed limits shall be a maximum is, that the vertices lie upon the limiting boundary so that the tangent at each vertex is parallel to the line joining the adjacent vertices. This is sufficient if no such tangent crosses the boundary at the point of tangency. The reciprocal of this polygon with respect to the limiting boundary, gives a polygon of minimum area whose sides lie without the boundary.

Maximum polygons inscribed in a given locus, are therefore particular cases of polygons inscribed so that the tangent at any vertex and the line joining the adjacent vertices meet on a given line, (the line at infinity). The p vertices of such a polygon count each for a pair of consecutive points upon the boundary; but these $2p$ conditions are not all independent if greater than the number of conditions which determine the boundary. For example, for $p = 3$, six $\left(\text{out of } \frac{n(n+3)}{2}\right)$ constants will determine a curve of the n'th degree, such that a given triangle is a maximum triangle inscribed in it; and if, for $n = 2$, these six constants were all independent, not every triangle could be a maximum triangle inscribed in a conic. The fact is that there are five independent conditions determined by the three vertices and the given line; and the sixth condition that the third tangent and opposite side shall intersect upon this line, upon which the other two tangents intersect their opposite sides, is simply Pascal's theorem applied to the hexagon formed by the three doubled points. If the conic is to be a circle, the vertices must satisfy two conditions, $\overline{12}^2 = \overline{23}^2 = \overline{31}^2$. If any point be taken, satisfying the single condition that it lies upon the conic $x^2+y^2=z^2$, the remaining $p-1$ points of the inscribed polygon, $z=0$ being the given line, are completely determined each by the two conditions that the coordinates of successive vertices are obtained by repetitions of the substitution $\begin{pmatrix} \alpha & \beta & 0 \\ -\beta & \alpha & 0 \\ 0 & 0 & \gamma \end{pmatrix}$ upon (x, y, z), where $\left(\frac{\alpha+\beta\sqrt{-1}}{\gamma}\right)$ is a primitive p'th root of unity. In any case, the number of independent conditions cannot exceed the number of constants in the form of the curve increased by the number of the vertices — which is the total number of constants at our disposal.

Similar conditions are applicable to surface content or volume content included by a given number of points in a limited portion of space; and so on. When the limiting boundary is a system of planes the vertices must lie at the points of intersection for a maximum content; and if these intersections are regularly arranged, the selection of a given number of them including a maximum content may be made in accordance with the principle that the points on the boundary consecutive (adjacent) to any vertex must lie within the locus generated by the given vertex moving so that the content included by it and its adjacent vertices remains unaltered. The simplest problem of this kind is that (brought up at the last meeting of the Society) of finding the maximum value of a determinant of n'th order whose constituents all lie between two fixed limits.

BIOLOGY.

An Improved Method of Varying the Thermal-Background of Reflex-perception, a Note by W. T. SEDGWICK.

[Abstract of a communication to the University Scientific Association, December 6, 1882].

The background of conscious preception, physiologically speaking, is that standard (usually unconsciously held) with which we compare any stimulus which awakens consciousness. The pricking of a pin is only perceived after it has attained sufficient intensity relative to a background of other stimuli, to arouse a consciousness of its existence; *i. e.*, it is *difference* of condition or stimulation which makes itself felt.

In the same way we may regard a reflex-background as existing relatively to stimuli which can produce movements only when the difference between them and the background becomes sufficiently great.

It is plain that such backgrounds may vary from time to time under varying conditions; so that a stimulus which to-day provokes consciousness or movement, may to-morrow fail to produce either. A pin-thrust would be unperceived by one whose hand was being crushed, and a drop of acid on the left foot of a frog may cause no movement when the sciatic nerve of the right leg is powerfully stimulated by electricity. In these cases a background commonly responsive is so profoundly affected by the greater stimulus as to neglect the lesser—and an impression so conspicuous and so effectual is called an "inhibition."

Quite aside from a background so disturbed, we may have one in which comparative equilibrium exists; and in order to bring about inequilibrium any stimulus must likewise here produce an effect sufficiently different in intensity, or in kind, from the background with which it is to be compared. A little reflection will show that in this case the stimulus does not commonly need to be so great as in the more complex case of inhibition, since in inhibition not only the resistance of the background but also of the other stimulus has to be overcome.

The reflex-background has been studied hitherto chiefly in connection with inhibitions, but in so far at least as thermal stimuli are in question the author has devised a means of varying, uniformly and gradually, the background as a whole, and of observing the effect upon reflex actions of such variations.

The method is as follows: A decapitated frog is so hung in a moist chamber as to allow one leg to dip into water, which can be gradually heated from the temperature of the animal upwards. If the heating be rather slow, say ten minutes of time in passing from 20° to 80° C., no reflex actions are to be seen; the heart, however, will get to beat very fast and the temperature of the frog will rise several degrees. *Rigor caloris* may even be attained without movements having been awakened. If this experiment be made upon another decapitated frog, and the heart, just before the heating begins, be tied so as to stop all circulation, a very different result will be obtained. After a few minutes the frog withdraws his foot or makes evident reflex movements with it.

The only plausible explanation seems to be that so long as the circulation exists there is a constant and progressive heating of the whole animal by the hot venous blood brought from the skin of the immersed leg, as well as a slight cooling of the skin of the same leg by arterial blood brought hither. The heating of the whole frog is the chief event, as by it the background of temperature with which all thermal stimuli must become contrasted is constantly changing, and in a direction which prevents any great difference between stimuli and background; hence movement never follows. In the second case, with no circulation, the background remains fixed, and the temperature of the water, when rising, gradually approaches that degree of difference requisite to produce movement, which finally ensues. It is held that we have here a useful method for the study of the respective relations of thermal stimuli, inhibitions and a variable background of reflex perception, since it is now quite easy to make comparative experiments, using backgrounds and stimuli of various temperatures.

On "Latent," or "Resting" Periods of Vegetation, a Note by W. T. Sedgwick.

[Abstract of a communication to the University Scientific Association, December 6, 1882].

It is well known that certain structures, especially winter-buds and some bulbs, tubers, seeds, and spores—however favorable their environment, absolutely refuse to respond to it by any perceptible growth until after the lapse of a considerable period of time. For example, potatoes and onions, if planted immediately after they are fully ripe and if kept warm and moist in a favorable soil, refuse to sprout until a period has elapsed so long as to forbid the idea that the conditions directly produced the event, or even materially aided it. If kept all the winter and planted in the same way in the early spring, they sprout forthwith; and from the early springtime sprouts appear even under unfavorable conditions—often in dry cellars attaining a considerable length so that the farmer must rub off the young sprouts from his potato-tubers before offering them in the spring market. Winter-buds are formed in the spring, then cease to develop and pass into a "resting-period" of nearly a year's duration. If plucked in the autumn, or if brought within a hot-house, it makes no difference how much sunshine, warmth, and moisture they receive; except in rare cases, they will not unfold until the ordinary allotted time.

On the contrary, some seeds—as wheat, rye, etc., and some spores—as *Mucor*, *Penicillium*, etc., always sprout and grow as soon as warmth and moisture are supplied; while still others exhibit long resting-periods. The farmer is very jealous for the safety of his grain, lest it shall "grow" in the sheaf during a rainy harvest; but his potatoes he digs at his leisure long after they have ripened.

Equally striking contrasts occur in closely allied species. The spores of most ferns germinate only after a very long resting-period, from which no amount of solicitude can awaken them; yet in a few cases the spores of ferns germinate immediately if given warmth and moisture, and speedily lose their power to sprout if deprived of such accessories.

These "resting-" or "latent-periods," have been for a long time a puzzle, no explanation of them, so far as the writer knows, having been offered hitherto. The point of greatest interest, is their indifference to the environment. Now it is the chief peculiarity of inherited qualities that they are practically independent of the present environment, and the cases mentioned above are so plainly not merely independent of, but even indifferent to the environment, that we cannot doubt that they are purely hereditary. Hereditary peculiarities, however, are usually, if not always, selected advantages derived originally from the environment. Let us see how such peculiarities might have arisen in the cases under consideration; and the simplest cases perhaps may give us the first clue.

Resting-periods in the lower groups, *e. g.*, algae and fungi, are oftenest due to unfavorable conditions in the environment. The "ascospores" of yeast, the "zygospores" of *Mucor* and of *Penicillium*, and the resting stage of *Protococcus*, are all brought on by unfavorable conditions of food, moisture, or warmth. These structures pass into the active stage only after some time; *i. e.*, they have latent periods.

Applying this idea, viz: that latency is an adaptation to bridge over unfavorable periods, we notice that resting-periods are more or less closely connected with the seasons. If, however, we undertake to account for latent periods by the development of the seasons, we have first to meet the great difficulty that within the same group of plants some exhibit latency while others do not. A case in point is presented by the ferns of the northern United States; a detailed examination of them will therefore be of interest. Inspection discloses that we may arrange them in two distinct groups:

1. Ferns ripening their spores early (in May) and the spores germinating within a week.

2. Ferns ripening their spores late (in July–September) and the spores germinating only after two or three months.

The former group displays no latency worthy the name, the latter a very pronounced amount.

Ferns flourished in the equable climate of the carboniferous age; they are now chiefly tropical and have but a feeble foothold in temperate regions; an indication that cold is an unfavorable condition. If we suppose our ferns to have accustomed themselves to the slow development of seasons since the carboniferous, or to have migrated gradually from the tropics, we have a possible key to the difficulty. Assuming that the spores of tropical ferns germinate quickly (a safe assumption, since latency is rare in tropical vegetation), it is clear that with the gradual development of the seasons two possible courses lay open:

1. The ferns might come to ripen spring spores of speedy germinating power (by which process the young fern plants would be rooted and fixed before the winter had come), or

2. The ferns might come to ripen, late in the summer, spores which should germinate only very slowly (*i. e.*, not until the next spring, when they would have an early start and an obvious advantage).

Those which adopted outside or intermediate courses, would perish during the winter. For instance, a spore having a long period of germination, if it ripened in May would be in its tenderest state by November; while if a September spore sprouted at once, it would be in a similar plight.

The phenomena which we actually find present the simplest conceivable means, upon this theory, of escaping destruction, and therefore in the end, more likely to prevail. As a matter of fact, the ferns ripening autumn spores outnumber those having spring spores, and seem to be most successful in the struggle. A little reflection will show that they might be expected to do this. It is the safest plan.

Lest it be claimed that the assumption of quick germination in the tropical, or carboniferous, ferns is unfair or unwarrantable, it is necessary to point out that we would be driven to the same conclusion if we assumed the worst cases for the theory, viz: slow germination or variable periods of germination. The latter would be even simpler than the one given above. The former would necessitate a gradual but total change in some and a preservation of the original time of germination in others; but it is scarcely supposable that all tropical ferns should have ripened their spores simultaneously and have imparted to them equal amounts of profound latency; yet whatever premise be adopted, the slow passage from a perfectly even climate to one displaying periods alternately favorable and unfavorable, must have brought about changes. So, too, must slow migration from the tropics into cooler climates; and the two conditions which we actually find are the most natural consequences of such changes.

If this solution be adopted for the problem of latency in the fern-spores, it can serve equally well for other plants. Thus, the witch hazel (*Hamamelis*), the sweet-gum (*Liquidambar*) and the *Fothergilla* belong to one family. The first blossoms in October and ripens its fruit early in the next summer. The second and third blossom early in the spring and ripen their fruit forthwith. In this case the witch-hazel resembles the ferns which bear autumn spores, the others the ferns bearing spring spores.

The cases mentioned above require no special explanation. Wheat and rye need no latent period. They grow at once and endure the winter's cold very well. It is the reverse with young buds—development and exposure, save in early spring, would kill them. So, too, with potatoes and onions.

To sum up, we may say that the gradual development of seasons, or a migration from the tropics, gives a sufficient explanation of the inherited tendency to latent periods which we find in some cases while it also accounts for the absence of any such tendency in other cases.

Pleomorphism in PENICILLIUM. *A Preliminary Communication, by* W. T. SEDGWICK *and* J. R. DUGGAN.

The observations and theories of Turpin, Bail, Hoffmann, Hallier, and Trécul, who claimed all sorts of polymorphism for *Penicillium*, gave in the hands of DeBary, Cohn, Reess, Brefeld, and Pasteur, results so utterly negative that anything looking toward pleomorphism in that fungus must undergo the very strictest scrutiny before it will be accepted as veritable. No one is more certain than we that it is far easier to leave loopholes for the entrance of outside spores than to detect actual transformations; no one more sure than we are that our work will be met with incredulity if not with contempt; nevertheless we are confident that we have discovered, and that we are able to *prove* that we have discovered, a new and peculiar stage in the life history of the common blue mould, *Penicillium glaucum*, Lk.

In a case of this kind it is necessary to be extremely explicit, and we hope to disarm a portion of the skepticism which we anticipate by frankly avowing that we have not changed *Penicillium* into *Saccharomyces cerevisiæ*, nor *vice versa*. We have not converted it into *Bacillus* nor *Micrococcus*, nor have we changed any of the bacteria into any of the mycelium-fungi. That which we have done we will briefly describe.

In the course of some studies upon fermentation we had occasion to prepare ten per cent. solutions of sugar; and for this purpose we dissolved rock-candy in distilled water. A large flask—nearly full—stood for two or three weeks, in diffuse daylight, unopened. At the end of that time a rather abundant and remarkably delicate, cottony growth was noticed *at the bottom of the flask*, and excited some interest from its evidently flourishing condition under circumstances so unfavorable. It was examined and pronounced to be remarkably like *Penicillium*, from which it differed morphologically chiefly in its subtle delicacy, and physiologically in its singular habit of bottom growth.

At this first examination, the presence of certain swollen regions was commented upon, as well as numerous minute, globular, and highly refractive bodies lying within the hyphae. The flask was once more closed, and would have been forgotten had there not shortly appeared a singular blackening of the delicate vegetation. Curiosity was again excited and speedily rewarded by the discovery of a surprising change. The shape of each plant as a whole was kept intact, but nearly every cell, especially near the presumable point of origin of the plant, *i. e.* near the locus of the ordinary erect hyphae which always grow most abundantly near the spore from which the ordinary hyphae have grown, was subdivided into several cells, and each of these had become round and greatly enlarged.

Enough had now been seen to warrant investigation, and we have found it easy to sow the spores of *Penicillium* in ten per cent. solution of sugar and to get the delicate vegetation. We have made ourselves positively certain that the vegetation is that of *Penicillium* by experiments—macroscopic and microscopic, which cannot be given here. The cottony growth does not always change into the spore stage—for such the blackened form proves to be—with ease; and exactly the needful conditions cannot yet be given; nevertheless we have found no difficulty in getting great quantities of the spores by chance. During development from the spore, cane sugar seems to be first inverted, and finally some alcohol and acetic (?) acid formed. When the black spores are fully ripe the hyphal *Penicillium* readily breaks up into numerous separate spores, each of which is somewhat oval, having its short diameter about twice the width of an ordinary *Penicillium* hypha, being provided with a thick exosporium and a delicate endosporium; bristling with a very fine covering of what appear to be minute spines, but most likely are calcium oxalate crystals, and enclosing some protoplasm, but especially several conspicuous large and shining oil drops. If not disturbed, these spores may retain a moniliform arrangement—the beaded rows being in disposition exactly identical with the hyphae from which they have come, so that a very low power would scarcely detect a change except in color; but the new cells are really independent spores as will shortly appear.

Our next endeavor was to get these spores to germinate; and this they do in a most lively manner, *e. g.* in a filtered solution of book-binder's paste. Our greatest desire has been to keep out other organisms. In the sugar solution we had a most favorable fluid, since scarcely anything besides *Penicillium* and a very few bacteria made its appearance. In book-binders' paste solution, which is a fluid too poor to be very tempting, the conidia of *Penicillium* germinate finely; hence we employed it for our spores, and after 36–48 hours were so fortunate as to see germination fully under way.

The germination takes place as follows: Swelling occurs, followed by bursting of the exosporium and a greater or less protrusion of the endosporium. The oil globules seem to become fewer. The endosporium bulges out, and though commonly merely protruding, in a few cases has been seen to grow to twice or thrice the length of the spore. After this greater or less protrusion a bud appears on the convex endosporium—at first very minute but getting, every minute, larger. Into it, apparently, flows protoplasm from behind, and it grows out to become a bud—formed precisely as is a bud upon a yeast cell. The bud is club-shaped, being attached by the smaller end. This eventually gives way, and the bud as an oval cell floats free in the liquid. It continues to grow, however, and often, indeed usually, itself produces numerous buds. The number of cells budded off from the endosporium is very great. We have seen as many as four being budded off at a time from one spore, and have watched the whole process of budding, which for a single bud frequently occupies less than half an hour. In this way the paste solution soon teems with unicellular organisms which have come originally from the blue mould.

It is important to note the fact that in germination, even if the ordinary moniliform arrangement be preserved, each cell germinates independently, and hence we are at liberty to regard each "spore" as such in fact as well as in name. The plant in its unicellular budding stage would certainly be called a "Torula" by almost any one, and it resembles somewhat the *Saccharomyces apiculatus* of Reess. It does not appear, however, to be an alcoholic ferment, but sets up changes which produce great ropiness and viscosity in liquids. Our investigations have but just begun, and we hope next to win back the ordinary hyphal *Penicillium* from this anomalous "Sprosspilz." If the latter proves to be a viscous ferment we may get light upon some vexed questions.

We reserve for our complete paper the discussion of all questions as to nomenclature, chemical and physiological changes, etc., merely adding here that these black spores, except in not being produced by conjugation, resemble somewhat the zygospores of *Mucor Mucedo*. Nevertheless, it is perfectly clear that they are not zygospores in the ordinary sense.

Preliminary Note on the Further Investigation of the Action of Digitaline on the Circulatory Organs, by H. H. DONALDSON *and* L. T. STEVENS.

The continuation of the experiments begun last year has yielded the following results:

The work done by the heart of the common frog is decreased by digitaline, whatever the dose, as was previously shown to be the case for the heart of the "slider" terrapin. In both frog and terrapin, the decrease occurs whether the aortic valves are intact or not.

Variations in arterial or venous pressure do not affect the result.

By a method permitting direct measurement of the fluid circulating through the viscera and lower extremities in a unit of time and under constant pressure, it has been determined for the frog that the arterioles are constricted by digitaline. On this point the terrapin has not yet been investigated.

Digitaline has also been shown to increase mean blood pressure in both frog and terrapin.

We have then for the frog under digitaline a decrease in the work done by the heart; a rise of mean blood pressure, and a constriction of the arterioles.

The first and second of these points have been already demonstrated for the terrapin as well.

PHILOLOGY.

New Testament Autographs, by J. Rendel Harris.

[Abstract of a paper read at the University Philological Association, January 5, 1883].

The object of this paper was to point out a method by which the text of the oldest manuscripts of the New Testament could be resolved into the papyrus sheets of the original documents. It was first shown that the second and third epistles of St. John were almost exactly equal in length, and probably, therefore, represented an integral number of sheets of the original writing. It was then established, by means of a table constructed from data supplied by the Vatican Codex, that of the various books of the New Testament contained in that manuscript, and which always begin at the top of one of its triple columns, a number show a preference for ending at the twenty-seventh or twenty-eighth line, instead of having their endings distributed at random among the forty-two lines which compose the several columns. The probability of such an arrangement being the work of chance was shown to be extremely small.

From this fact was at once deduced the sub-division into the original papyrus sheets represented by fourteen lines of the Vatican Codex; and the actual number of sheets was determined for those books to which the method applied. It was further shown that these sheets must represent very closely the original sheets of the autographs; for, if the original form had been deserted, a random distribution of endings would have been set up. This resolution of the page of the Vatican Codex into nine elementary pages arranged in a square, so that three form a column and three columns a page of the MS , gives the name of V-page to the resolved elements.

A similar analysis for the Sinaitic Codex demonstrated the existence of sixteen pages, of a somewhat smaller size, characterized as S-pages arranged also in a square, four S-pages to the column and four columns to the page.

The importance of these investigations in the field of textual criticism was shown by some illustrations. It was maintained that the celebrated Pericope de Adultera, which stands at John vii. 53, in ordinary Bibles, and is rejected almost unanimously by the critics, was in reality four V-pages of the autograph of St. John, omitted either accidentally or by intention. And it was further pointed out that the passage had been wrongly restored, and should probably stand at the end of the 5th chapter of the Gospel.

A similar analysis showed that the celebrated verses which contain the account of the Agony in the Garden were an S-page dropped from the autograph of St. Luke.

The bearing of these results upon the stichometry of the New Testament was then discussed; and a high degree of probability was shown for the assertion that the types of the Sinaitic and Vatican MSS. are the two principal patterns employed by scribes of the time, and represent the half of the iambic trimeter and of the heroic hexameter respectively. This conclusion was verified by the study of some passages from the edict of Diocletian; and a rough calculation was made of the cost of the production of the Sinaitic Codex, from data supplied by the edict, the result obtained being approximately 30,000 denarii. The first part of these researches into the form of the autographs and of the examination of their bearing upon the general criticism of the New Testament, will be given in a supplement to the December number of the *American Journal of Philology*.

On the Importance of Latin Glossaries with special reference to Codex Sangallensis 912, Saec. VII–VIII, by M. Warren.

[Abstract of a paper read at the University Philological Association, January 5, 1883].

Attention was called to the fact that a large number of Latin Glossaries, ranging in date from the seventh to the twelfth century, are found in the different libraries of Europe, more particularly in Leyden, Paris, Munich, Rome, Vienna, St. Gall, and Berne, which have never been edited nor even carefully examined. It was shown that those glossaries contain valuable remains of the ancient commentators and grammarians often abbreviated, and sometimes mutilated beyond recognition, but which, with the aid of proper criticism after exact collations have been made, may be of service to future editors of Varro, Festus, Nonius Marcellus, Gellius, and Macrobius. We may confidently expect great gains from them for Latin lexicography in general, as well as for the elucidation of rare and obscure words already known in Plautus, in the fragments of Ennius, Lucilius, and other authors. Many new words and forms may be found which will be of interest to the student of word-composition and derivation—the corrupt orthography will often shed light upon phonetic tendencies of late Latin—while the interpretations themselves may reveal the obsolescence of certain classical idioms.

A description was given of codex Sangallensis 912 of the seventh or eighth century, of which a copy had been made by the writer in the summer of 1881. It contains 320 pp. and upwards of 5000 glosses. It is closely related to the cod. Vindobonensis 2404 and cod. Vaticanus 3320, both of the ninth century. Dr. Gustav Loewe, in his Prodromus Corporis Glossariorum Latinorum, p. 139, calls it "*praeter Vaticanum 3321 omnium codicum quotquot hac usque noti sunt vetustissimus.*" It begins with *abba: pater* and closes with *sipherus: ventus*, with the subscript EXPL. ERMENEVMATA DO̅ GRATIAS AMEN.

It contains one Gothic gloss *baltha: audax* and a considerable number of Greek and Hebrew glosses. Among the orthographical peculiarities are the use of *d* for *t*, *padior*, *bruda*; *t* for *d*, *multituto*; *b* for *p*, *abricum*; *b* for *v*, *baccae* for *vaccae*; *v* for *b*, *cavallares*; *o* for *u*, *nodrix*; *l* for *d*, *apoliterium* for *apodyterium*, the loss of final *m* and *t*. Emendations based upon glosses contained in this MS. were proposed for several glosses already edited, *e. g.* in cod. Leidensis 67 F^1 *Depalata: manifestata, devolata*, *devolata* is a corruption of *divulgata*. In gloss. Amplon. *Tesserarius: praepositus currorum qui bella nutriunt*, *nutriunt* should be *nuntiant*, cf. Vegetius II, 7,—cod. Par. (Hildebrand, p. 181) *inspicare: diffidere vel modum spicare*, was originally *diffindere vel in modum spicarum concidere*, and refers to Verg. Georg. I, 292.

In cod. Leid. 67 F^1 *Diaria: acibo sed unius diei*, *acibo* is for *actio*. Isidorus, Or. I, 63, explains *Diaria* as *unius diei gestio*. For cod. Leid. 67 E, *Barbustinus: homo qui fert barbam plenam prorisinis*, where Scaliger wished to read *plenam porriginis*, the Sangallensis has *barbarostomus: homo qui barbarismis plenum profert verba*. Relics of early tradition were illustrated from the glosses *nis: nobis* cf. Festus under *Calim*, p. 47, *nusciosus: qui plus vepere videt*, cf. Festus *nuscitiosus*, p. 178, *lixa: aqua dicebant antiqui inde elixare dicitur*, cf. Nonius, p. 61. The paper concluded with a list of new words found in this glossary.

Arthur C. Burnell and the Talavakāra Brāhmaṇa by M. Bloomfield.

[Abstract of a paper read at the University Philological Association, January 5, 1883].

The object of this paper was partly to commemorate the life and works of Arthur C. Burnell, who died on the 12th of October, 1882, and partly to mention and describe shortly the Talavakāra-Brāhmaṇa, the unique manuscript of which is now in the hands of Prof. Whitney of Yale College, it having been turned over to him by Burnell. Burnell was the pioneer for Sanskrit and particularly Vedic studies in South India. Beginning his career there as an official he was first attracted like so many others to the study of Hindu law and his three first publications were in law-literature. Towards the end of his career he returned to the same studies, and promised several important works, among others a translation of the laws of Manu, in which he had advanced so far, that its publication is still ultimately looked for. More important were his studies in Vedic literature, especially in the Sâma-Veda, of which he published five Brâhmaṇas, among them the Vamça-Brâhmaṇa, famous for its introduction, in which the commentator Mâdhava is ingeniously identified with Sâyana. But his chef-d'œuvre was the laborious catalogue of the 12,000 MSS. deposited in the palace of Tanjore and the palaeographic work resulting therefrom in his two editions of the "Elements of South-Indian Palaeography." In this he did for the palaeography of South-India what James Prinseps had done forty years before for that of Northern India. He also published important works on native grammar, the dialects of South-India and other interesting subjects. Looking back at his short life of forty-two years, spent largely in poor health, one knows not what to admire most: his heroic persistence in hard work in a tropical climate, or the true instinct with which he always directed his efforts towards the most needful and original work.

Burnell's labors on the Sâma-Veda were alluded to above. His best achievement in its behalf is the discovery of a Grantha MS. of the Talavakâra Brâhmaṇa, which he made over to Prof. Whitney, who copied a large part of it himself, and distributed the remainder, to be copied by younger American scholars, among them the writer of these lines. The copy will be deposited, for the use of American scholars, in the library of the American Oriental Society in New Haven. This Brâhmaṇa was known for a long time only by the mention of Çañkara, the celebrated commentator, in connection with the Kenopaniṣad. He there asserts that this Upaniṣad forms a part of the ninth chapter of the Talavakâra-Brâhmaṇa; Burnell succeeded by what he calls modestly "a lucky concurrence of circumstances," in ascertaining that it actually existed and in obtaining a copy of it. The Talavakâra is the largest specimen of the Brâhmaṇa literature, and, according to Burnell, it is even more archaic than the Çatapatha-Brâhmaṇa. Prof. Whitney will utilize this important work for the second edition of his Sanskrit Grammar, and for the collection of verb-forms, which he will add as an appendix to that work.

A Note on the Chalkidians, by C. D. MORRIS.

[Abstract of a paper read at the University Philological Association, December 8, 1882].

It was argued at the meeting of the Association in November that the statement of Plutarch, Per. c. 23, that the Chalkidian nobles were banished from Chalkis after the reduction of Eubœa by Pericles in B. C. 445, though accepted by the modern historians of Greece, was probably erroneous, as being inherently improbable and as controverting the natural inference from the words in which Thucydides records the results of that expedition. The conclusion then arrived at on such grounds is proved to be correct by the words of the Inscription (C. I. A. iv. n. 27, Hicks, p. 33) which dates from immediately after the reduction of Eubœa, and records the terms on which Chalkis was admitted once more to the Athenian alliance. From this we learn that the Athenian *βουλή* and *δικασταί* were required to take an oath of which the first words are, *οὐκ ἐξελῶ Χαλκιδέας ἐχ Χαλκίδος*. Mr. Hicks explains the import of these words thus: "The Athenian *βουλή* is not to deal with Chalkis as it had just dealt with Hestiaea (Thuk., i. 114) and as it had with Chalkis itself in B. C. 509–4 (Herod., v. 77)."

Quantity in English Verse and the Hexameter, by A. H. TOLMAN.

[Abstract of a paper read at the University Philological Association, December 8, 1882.]

Quantity in English verse is usually overlooked and often denied. One cause is the variable value of many syllables; another, the influence of accent upon quantity. Accent is of three kinds: — pronunciation accent = stress (1 degree) + pitch (change); rhythmic accent = stress (2 degrees) + pitch (change); logical accent = stress (3 degrees) + pitch (change + slide). A syllable upon which the second of these accents falls must already have the first, and one which receives the third accent must have the first two contained in it. Swinburne often violates this rule. Short-voweled syllables ending in a consonant, not a surd or sonant mute, are frequently lengthened by prolonging this consonant, if these syllables have the rhythmic accent. Similarly, the *initial* consonant may be prolonged when the syllable has the logical accent. Not all short-voweled syllables can be lengthened by accent. An accompanying rest may allow a short syllable to be used as equivalent to a long one.

As regards position the limit of good short syllables is, perhaps, this: a short-voweled syllable *may* be short before two mutes or two mutes and a liquid. Violations of the time are sometimes allowable, if they are a positive element of expression.

The Hexameter. Representing its short syllable by ♪, we say that the hexameter is in $\frac{4}{8}$ time, or in 4-rhythm. This time is common in spondaic hymns. There is difficulty in distinguishing between light dactyls (♪♪♪) which are not in $\frac{4}{8}$ time, and heavy (♩♪♪). Heavy dactyls are found in later English poetry, especially. Writers of the hexameter have usually disregarded either accent or quantity. The legitimate hexameter must carefully regard both. A hexameter translation of the Iliad must not use polysyllabic, foreign derivatives. The objections to a hexameter translation are:—1. The monosyllabism of English. The number of words per line in specimens of the Iliad, Evangeline, and Matthew Arnold, is 6.4, 11.4, 11.9; — 2. The uninflected character of English. The uniformity in the position of the caesuras in the hexameter is less felt in an inflected language, where arrangement is freer. Caesuras in blank verse may come anywhere.—3. The consonantal character of English. The number of mutes per line in passages from the Iliad, Mr. Howells, and Mr. Arnold, is 6.9, 12.6, 11; and of other consonants per line, 9.2, 12.1, 12.5.

The number of letters to a line in the first five lines of Paradise Lost (Greek spelling) is 29; in the Iliad, 32.8. If these 10 syllables are increased to 15, the lines will drag, even if an emasculated diction is employed to avoid it. The dragging of the English hexameter is a positive element of expression in poems expressing sorrow, melancholy, etc. This partly explains the popularity of Evangeline.

On a Fragment of King Alfred's Anglo-Saxon Translation of Gregory's Cura Pastoralis, *by* J. W. BRIGHT.

[Abstract of a paper read at the University Philological Association, December 8, 1882].

A copy of the *Marburger Lectionscatalog* for the winter-semester 1854–5 was presented, in which Prof. Franciscus Dietrich edited a fragment, consisting of some twenty lines of the Anglo-Saxon Pastoral. The fragment was found at Cassel, and no one since Dietrich, who himself gave no outward description of it, appears to have seen it. Prof. Zupitza in 1876 mentions merely the above Catalogue, (Z. f. d. Alterthum xxi, p. 1, note). Mr. Sweet, the editor of the contemporary MSS. of King Alfred's writings, has evidently not yet become aware of even the catalogue. Special attention was called to the character of the fragment. It was found to agree closely with Hatton 20, and to be genuine Early West Saxon in dialect. It is not a transcript made from the Hatton, but possibly from the same original from which the latter was made. The fragment reads *midfeorwe*, and thus favors Mr. Skeat's interpretation of *mid feorwe* in Hatton (vide Mr. Sweet's Notes, Early English Text Society, No. 50, p. 491).

GEOLOGY.

Geology of the Surface Features of the Baltimore Area, by P. R. UHLER.

[Abstract of a communication based upon field work of the recorder, and mostly given in a lecture before the Naturalists' Field Club, January 7, 1883].

The principal features of the Baltimore Area are expressed, first, in the hard rocks of the Archaean Age, cut into bold plateaus, rising like series of wavy steps on the north, north east, and west of Baltimore city; secondly, by wide beds of alluvial clay, sands, and drift materials extending like ridges through the city and its suburbs in the direction of tide-water.

The two series form belts of surface; the former running nearly parallel to the continental eastern axis of North America, while the latter rests upon the outer border of the former, fits into its figure, and stretches away under the Patapsco river, Chesapeake bay, and the eastern shore of Maryland to an unknown distance.

The first is underlaid by the Laurentian system of rocks, holding the Chloritic and Serpentine series, and supporting or embracing the mica schists which are capped by certain coarse and open quartzites.

This belt is a necessary member of the eastern upfold of the United States, and constitutes the remnant of an ancient mountain system, bearing a general north north-east by south south-west course, which formerly separated the waters of the coast from the river and lake system of the region now occupied by Parr's ridge.

As at present seen, the summits of these plateaus are reached at a distance of about eight miles from Baltimore. That on the west being about two miles beyond Catonsville, now reaching an altitude of more than 500 feet above tide; the next being slightly lower crosses the country beyond Pikesville; while that on the north-east does not rise over 400 feet above tide, and gradually tapers off towards Chesapeake bay. The rocks in this latter ridge are ground down to an altitude of less than 325 feet above sea level, and are covered by a deposit of roughly stratified sand and gravel about 75 feet in thickness. This may best be observed on the Belair road, at the crossing of White Marsh run.

All of these plateaus have been shaped by erosion, and more lately by the decomposition of their exposed surfaces.

During the Jurassic Period these Archaean upfolds seem to have attained their maximum development. Compression, occasioned by the shrinkage and drying of the crust, thrust up mighty folds, certainly more than a mile in height, and let down adjoining folds to a corresponding depth. At the same time these rocks were plastic, and undergoing metamorphism in contact with heated waters, steam, and gases; and wide spreading, while comparatively local changes, were moulding them into granites, gneiss, syenites, porphyries, and other rocks, in astonishing variety. All of these had been laid down in oceanic waters, some as coarse gritty mud, others finely and evenly mixed, and still others as conglomerates holding fragments of feldspar, quartz, and mica of every size and form. Some of the large pieces appear to have been rounded boulders, in a few instances larger than an ordinary dwelling-house.

These folds were continued in serial order to an unknown distance westward, but certainly as far as to the present centre of the base of the Catoctin Mountains. On their eastern border they formed shorter and less elevated curves, and they are similarly arranged on the western border, about twenty miles north of Baltimore. Next beyond that line they are covered by a great thickness of metamorphosed mica schists, which fill the adjoining synclinal basin and stretch forward into Frederick county, where they become concealed beneath the slates of the Monocacy valley. These schists seem to rest conformably upon the older rocks, which are there distinctly stratified and hornblendic at all the visible points of contact. They now rise to an altitude twice as high above tide as the older rocks, and form a nearly closed synclinal next the summit of Parr's ridge.

Several anticlinals with wide synclinals occupy the interval between Druid Hill Park and the western border of the belt. Several of the latter are now deep valleys, overspread by a thick sheet of white, crystalline limestone or marble. These valleys are generally more or less elliptical in outline, and are at most only a few miles (3 to 5) in length.

Tracing the Archaean rocks along the axis of their upfolds we are led to Canada in the one direction, and to Georgia in the other. But there are many restricted elements in the structure of the Baltimore rocks which serve to give them character and to separate them broadly from members of the series found in other parts of eastern North America. Thus the hornblendic and pyroxene rocks are especially abundant here, while the extremely feldspathic are confined to a few localities, and are usually accessible only at low levels.

Passing by all the intervening epochs of Palaeozoic time, which built such huge monuments of rock structure beyond the western border of the Baltimore Area, the Jurassic Period is reached. Only the upper member of this great age of reptiles, the Wealden, now remains within this area. This formation extends from Elkton in Cecil county to beyond Washington, D. C., and rests directly upon the Archaean rocks, at least throughout its inner margin, and has an accessible breadth of about thirty miles. It pushes back in thin deposits as far inland as Timonium, and spreads between most of the higher hills, and over the lower ones at or above the inner limits of tidewater. It is overlaid by beds of the Cretaceous Period on the Severn river, and by the Tertiary and Post Pliocene formations at many points along its inner border. Huge piles of gravel, drift and boulders form hills [illegible] in the region near the estuary of the Gunpowder river, and it is covered by a layer of similar quartz-gravel and pebbles between the branches of the Patuxent river. Within the limits of the city of Baltimore, as along the deep cuts of North Avenue and in Federal Hill, several of its strata, above the white sand and fuller's earth, may be distinctly seen.

Beneath the bed of the Patapsco river at a distance of five miles from Baltimore it extends downwards to a depth of 400 feet, and to this may be added the strata resting above the level of tide, making in all a section fully 500 feet in thickness.

As a great mountain ridge stood between the formations of this Period and those of the Triassic, or New Red Sandstone on the west, we fail to find here any points of contact between these two great systems, apparently so nearly related in geological time. As far as the materials for comparison exist, the Triassic appears to be the older of the two, and consequently to assume many of the features of the Carboniferous Age. There is a resemblance between them in the composition of the sandstones and shales, and in the remains of plants and animals, so far as they have been obtained.

In the Jurassic, however, and especially in the upper series as represented in the Baltimore Area, the sandstones are of a more recent type, and no shales exist. The Flora has made a step in advance, and gigantic Gymnosperms take the place of the old Calamites and their relatives. The Wealden in this Area has been preëminently a marsh and lowland region; in which a great variety of tree ferns, ferns of the Sphenopteris type, Cycadites, Swamp Cedars, and on the uplands hemlock like conifers grew in the greatest abundance. The trunks of those latter are frequently found in the dark clays of the iron ore beds, and the branches and twigs form the bits of lignite which are so widely distributed throughout the clays of Federal Hill, and the adjoining peninsula.

The only animal thus far known to occur in this formation is the *Astrodon Johnstonii* Leidy, a reptile supposed to be related to the Iguanodon; but of which only a tooth and some fragments of bone have hitherto been found.

The whole series of the beds having been derived from the comminuted or chemically altered elements of the Archaean rocks, we find accordingly at the very bottom of the formation, a stratum of micaceous sand mixed with finely ground mica and aluminous matter. This is arranged in superposed layers, the fine white clay alternating with the white sand, until a thickness of 140 feet has been accumulated; next above this is a layer of pale clay, 20 feet in thickness, followed by 6 feet or more of fine white sand. And so sands, clays, gravel layers, and three different strata of cobble-stone drift, overlaid by other coarse drift and boulders set in red and pale clays, complete the series up to near the surface. Above these the gravel beds of the Glacial Period, with perhaps still others from the Champlain Epoch, rise in hills, or spread over the Wealden domes in deposits of varying thickness. To the Susquehanna river we must look for the broad avenue through which the general drift reached this Area, charged with boulders of fossil-bearing rocks torn from the mountains more than 70 miles distant.

The Wealden formations were built in comparative quiet as sediments at the bottom of shallow water, and near the upper part of the series, a thick stratum of white sandstone and conglomerate spread from the present shores of Chesapeake bay away back to the Belair road near the Gunpowder river.

The shattered remnants of this great sheet of stone may still be seen sticking out of the water in Rock Creek, at the mouth of the Patapsco river, and also in the soil of the region beyond White Marsh Run. The other end of this stratum passes across the Magothy river, outcrops on the Severn, and reappears in a ravine near Collingwood, on the Pope's Creek railroad.

About the close of this period, a colder climate prevailed, at least in the mountains on the west and north of this Area. Ice masses, loaded with stones and broken rocks, rushed furiously through the clay beds, tearing deep troughs in them, pushed huge masses of the uprooted matter into holes, and dropped it in their course seaward. Floods of water, also, poured through the channels of the rivers and brought down their quota of cobble stones and pebbles, which were afterwards driven over the tops of the lower hills and plateaus by the tides of the receding ocean.

Thus through unreckoned ages of time, our Baltimore Area was built up by successive stages of progress, which met first a body of old crystalline rocks, and then carved them into the varied reliefs and structures of surface that we observe to-day.

PHILOSOPHY.

The Fundamental Conceptions of University and Philosophy, by G. S. Morris.

[Abstract of a paper read at the University Metaphysical Club, December 12, 1882].

It was pointed out that the very conception of the University is a philosophical conception. This is suggested by the name University. The "*Universitas literarum et scientiarum*" is not a merely mechanical aggregation of all "letters and sciences," each of which is to be treated as ideally complete in itself and to be prosecuted in total disregard of aught but itself. On the contrary, the phrase in question points to the truth that all "letters and sciences" must be regarded as members of one organic whole, having, in spite of their specific differences, a common life and a common nature; so that no one of them can be truly or perfectly pursued—or, at all events, none of them can be pursued in the true "University" spirit—unless such pursuit be accompanied by an appropriate knowledge of the whole, of which, rightly conceived, it is an organic, living member.

This, the necessary and essential conception of the University, is specifically a philosophical one. For philosophy is peculiarly the "science of wholes." It is, in particular, the science of the whole of experience, or of experience considered, subjectively, with reference to its whole or universal nature and, objectively, with reference to its whole or universal content. It is thus, in its two inseparable parts, as Theory of Knowledge and Theory of Being, the Science of Science itself. Or, it is the science, whose subject-matter is all the sciences, considered, not separately, but as members of one living whole. Thus philosophy is—in the words which constitute the motto of the University of Kiel—the "bond of the sciences."

The relation thus exhibited, between the University idea and the idea of philosophy, is recognized in Germany by the name "Philosophical Faculty," which is given to the general Faculty in all or most of the Universities. The relation being admitted, the necessary place of philosophy in the life and work of the University may be at once inferred. Philosophy represents the catholicity of science, and it was argued accordingly, that one of the special functions of philosophy in the University is to act as a liberalizing agency, anticipating and so preventing the confessedly illiberal and narrowing tendencies of extreme specialism. On this point a citation was made from the recent inaugural address of Dr. Herm. Schmidt-Rimpler—himself a specialist—on assuming the rectorship of the University of Marburg (*Universitaet und Specialistenthum*, Marburg, 1881). The attempt was further made to show the connection of philosophy with the promotion of the more comprehensive and public aims of the University, which include the development in its members—along with symmetrical and catholic culture—of intellectual self-mastery, and the contribution to church and state, to science, literature, and religion, of leaders capable of recognizing the true ideals and of intelligently directing the nation's energies to their accomplishment.

Knowledge and the Relativity of Feeling, by J. Dewey.

[Abstract of a paper read at the University Metaphysical Club, December 12, 1882].

Modern attempts to show the impossibility of ontological knowledge have rested upon two different theories: one, that the nature of the cognitive faculty itself is such as to render it impossible for knowledge ever to transcend phenomena; the other, that all knowledge is derived from feeling, and feeling being demonstrably relative to a sentient organism, knowledge must be confined entirely to the affections of this feeling subject. The latter is the doctrine of English sensationalism. The paper was a criticism of this aspect of the theory, particularly as put forth by Mr. Spencer. It was also attempted to discover the positive meaning of the theory for philosophy.

In the criticism it was pointed out that relativity can be known only when it is known that there is an absolute object, and also what it is. But for feeling itself to furnish such knowledge implies that it can arrive at absolute knowledge, *i. e.* it contradicts the theory of its relativity. Furthermore, if all knowledge be derived from sensation, relations, as Mr. Spencer claims, must also be so derived. But this is merely to say that relation and so relativity is simply a feeling and has no objective existence. And so sensationalism again proves itself an inadequate basis for the doctrine which it claims to uphold. If the doctrine, then, is to be held, it can be only along with and based upon a theory of knowledge which permits and comprehends absolute knowledge, *i. e.* knowledge of objects as they really are.

Upon such a theory it was shown that the relativity of feeling means certain definite relations between two objects, one sentient, the other non-sentient, as given in immediate consciousness. And, furthermore, since these objects themselves have their existence only in and through relations to consciousness, self-consciousness itself turns out to be the true absolute, with reference to which knowledge is relative. Hence it was concluded that the relativity of knowledge does not imply the limitation or defect (subjectivity) of knowledge, but expresses its essence and excellence as consisting in and through relations to a self-consciousness which is not conditioned by the relations with which it conditions its objects.

PHYSICS.

A Determination of the Ohm in Absolute Measure now in progress under Professor Rowland's direction (Preliminary Notes), by A. L. Kimball.

[Abstract of a communication to the University Scientific Association, January 3, 1883].

Notice was given of the proposed re-determination of the Ohm; the method to be used being the same as that used by Professor Rowland in 1876, changes being made in the character and arrangement of the apparatus so as to avoid, so far as possible, the repetition of constant errors. A short account was given of the nature and importance of absolute measurement in general, in which the derived units are all based on the fundamental units of length, time, and mass, and derived directly from them. The nature of the unit of electrical resistance was then noticed, and attention called to the fact that in the electromagnetic system of units, the unit of resistance bears to the units of length and time the relation of a velocity. Mention was made of the most noteworthy methods that have been used in determining the value of resistance in absolute measure, attention being called to the manner in which the units of length and time entered into the experiments.

CONTENTS OF RECENT JOURNALS.

The American Chemical Journal, *Vol. IV, No. 5,* (January, 1883), contains papers as follows:

On the Analytical and Diastatic Action of Human Saliva, by R. H. Chittenden and J. S. Ely.

Determination of Organic Matter in Potable Water, by J. W. Mallet.

Minerals from Fritz Island, Pa., by Benj. Sadtler, Jr.

Manganese Borate, by N. Wiley Thomas.

Determination of Iron in Hydrochloric Acid Solutions by Potassium Permanganate, by N. Wiley Thomas.

On Certain Substances obtained from Turmeric-Curcumin, by C. Loring Jackson and A. E. Menke.

Turmeric Oil—Turmerol, by C. Loring Jackson and A. E. Menke.

On Ethoxy-metatoluic Acid, by P. H. Broun.

On Complex Inorganic Acids, by Wolcott Gibbs.

On the Action of Phosphorous Trichloride on Aniline, by C. Loring Jackson and A. E. Menke.

Under the head of "Reviews and Reports" appear:

On some recent Improvements in Industrial Chemical Processes, by Walter Weldon.

Physiological Oxidation.—Analytical Chemistry.

The number closes with notes and a list of new publications relating to Chemistry.

The forthcoming number (12) of the **American Journal of Philology** will contain articles by W. D. Whitney (On Eggeling's Translation of Satapatha-Brâhmana), J. Rendel Harris (On the Locality of Palladius), Fitzedward Hall (On Some Points of Usage in English), B. L. Gildersleeve (On the Conditional Sentence, and the use of AN and KEN in Pindar), C. D. Morris (On a Passage in Plutarch's Life of Pericles), Notes by J. M. Hart and H. E. Shepherd, Reviews, Reports, Correspondence, and the usual Bibliography. This number closes the Third Volume.

The first number of the Fourth Volume (Whole No. 13) will appear in the spring. Subscribers are requested to send in their names at once, as the management has determined upon a narrower margin for future demands. Price $3.00 per volume. The back [illegible]

COMMUNICATIONS TO THE HISTORICAL AND POLITICAL SCIENCE ASSOCIATION.

Reminiscences of Madison, by J. H. B. LATROBE.

[By special invitation, the President of the Maryland Historical Society, Hon. JOHN H. B. LATROBE, addressed the students of Historical and Political Science, December 8, giving his personal recollections of American statesmen, especially of James Madison and his contemporaries. The following report, drawn up from the notes of one of his hearers, has been submitted to the speaker, who has consented to its appearance here].

Mr. Latrobe's recollections of Madison extended as far back as the year 1810, when the latter, who was then President of the United States, was a frequent visitor at the house of the Latrobe family in Washington. Mrs. Madison and Mr. Latrobe's mother were intimate friends even before their respective marriages. Mr. Latrobe repeated, as the tradition of the family, that Gilbert Stuart was painting Mrs. Latrobe's portrait, using her drawing-room as a studio, behind a screen in which he kept his easel and painting material. Mr. Madison was paying a morning visit to Mrs. Latrobe while the sitting was in progress, and when, in the course of conversation, the painter spoke of his desire to paint the President's portrait, Mr. Madison said that although nothing could be more disagreeable than sitting, he was very willing to undergo the infliction provided some agreeable person like the lady of the house would converse with him during the process. Stuart then said that he was sure Mrs. Latrobe would aid him by consenting to change places with Mr. Madison, alleging that he had a canvas behind the screen on which the work could be begun at once. As said, so was it done; and the painter pretending to exchange the portrait just begun for a fresh canvas behind the screen, took the opportunity of turning the same canvas upside down, and effacing the head of the lady, painted that of the President in its place. This, of course, was only known afterwards — but neither the lady nor her husband were pleased, and it was in this way that the family failed to have a likeness of Mrs. Latrobe from the hand of the great artist.

Mr. Latrobe remembered distinctly the appearance of Mr. Madison at that time — a man of slight figure, of small stature, but with distinguished manners, and wearing, after a still prevailing fashion, his hair in powder. Mrs. Madison was a tall, beautiful, queenly woman, with a certain hauteur of manner.

An interesting letter was read, written by Mrs. Madison to Mrs. Latrobe after the capture of Washington by the British in 1814. Mrs. Madison said she left the White House only two hours before the enemy arrived. She barely had time to send away the silver and Stuart's portrait of Washington, which she cut from the frame. Such desolation she never saw as that which the British left behind them; but men said the city of Washington was destined to be greater than ever. Mr. Latrobe described the old Capitol and the famous Hall of Representatives of which his father was the architect. The British officer who had been deputed to fire the building said, upon entering that stately Hall, "It is horrible to burn anything so beautiful." Rockets were at first discharged into the dome, but this method of igniting the building proving unsuccessful, furniture was piled together in the middle of the chamber and then set on fire. Mr. Latrobe remembered attending the inauguration of Monroe at the time the Capitol was being rebuilt. He said he rode in the procession, which formed in front of a platform at the temporary quarters of Congress—(the Capitol Prison, well known during the late civil war). He remembered seeing Monroe and Madison as they stood side by side. Monroe was the taller man, but he was much heavier-looking and by no means so attractive personally or so distinguished in manner as Madison. Afterwards, there was a public reception at Mr. Monroe's residence, when any one that chose passed through the rooms and shook hands with the President. After the inauguration, Mr. Latrobe's attention was more attracted by the beauty of Mrs. Monroe than by the appearance of her husband, the President.

In 1832, the year of the cholera epidemic, Mr. Latrobe, when on his way to Virginia Springs, visited the Madison family at Montpelier. He carried a letter from his mother to Mrs. Madison. He found her looking much the same as fifteen years before. Her husband was greatly changed. He was now an invalid, lying upon a low couch,— an emaciated, mummy-like, little old man, with a weazened face, but with eyes still brightly sparkling. The young man sat by the bed-side of the old statesman from eleven o'clock A. M. until dinner, from which Mr. Madison finally called him away in order to resume the conversation, which continued without a break until dusk. After tea, the talk went on until bed-time. The next morning, Mr. Madison talked for half an hour longer, when Mr. Latrobe took his departure. During this long interview, the latter frequently expressed the fear lest Mr. Madison might be overtasking his strength. "Not at all," said Madison, "the only part of me that is sound is my lungs" He talked almost uninterruptedly, telling of the distinguished men he had known, dwelling with manifest pleasure upon his memory of Paul Jones, with whom he had had much to do. He spoke at length about Virginia and the varied characteristics of its population. He reviewed his experience at the great Constitutional Convention. One striking remark stamped itself upon Mr. Latrobe's memory. Madison said, "*The Constitution of the United States has two enemies: the one that would squeeze it to death, and the other that would stretch it to death.*" Mr. Latrobe regretted that he could not recall the many pithy sayings and the wealth of political wisdom in which that long interview abounded. There were so many good things that the mind of a young man could not possibly grasp them all. One comfortable saying of Madison's Mr. Latrobe recalled with evident satisfaction: "One of the pleasantest amusements in summer is to lie upon a lounge in a cool place and read a novel!"

Mr. Latrobe also gave his recollections of Jefferson, who at one time had considerable correspondence with Mr. Latrobe's father in reference to architectural designs for the University of Virginia and the old Hall of Representatives. Mr. Latrobe also knew Chief Justice Marshall, who had visited at the house of the Latrobes in Washington. Mr. Latrobe thought the likeness recently published in *The Century* (December, 1882) most admirable. Mr. Latrobe gave interesting reminiscences of John Randolph, John Quincy Adams, Henry Clay, and Daniel Webster. Charles Carroll of Carrollton, of whom there is an excellent likeness in the gallery of the Maryland Historical Society, was also well known to Mr. Latrobe, who was once employed to collect Mr. Carroll's rents from tenants living only upon fever and ague in the Piny Woods of Anne Arundel county. Although of course Mr. Latrobe was unsuccessful, yet Mr. Carroll insisted upon paying the young lawyer's fees and expenses with scrupulous exactness, down to the last twelve and a half cents.

The Peninsula Campaign of 1862, *by* WILLIAM ALLAN.

[Abstract of an informal lecture, illustrated by military maps, by William Allan, (formerly Lieutenant Colonel and Chief Ordnance Officer, Second Corps, Confederate Army of Northern Virginia), at the Historical and Political Science Association, December 15, 1882.]

A view of McClellan's Campaign against Richmond in 1862 was given from a Confederate standpoint, with allusions to recent works on the subject, especially Webb, Swinton, and the Papers of Mass. Mil. Hist. Society. This campaign may be conveniently divided into four periods: the first comprising the consideration of plans, the final adoption of the Peninsula route, and the transfer of the Federal army to Fort Monroe (January to April 8); the second, the siege of Yorktown (April 4 to May 4); the third, the Federal advance to the Chickahominy and the battle of Seven Pines (May 4 to June 1); the fourth, the concentration of the Confederates and their final attack on McClellan in the Seven Days' Battles (June 2 to July 8).

In the first period the utmost vigilance was required on the part of the Confederates to meet their adversaries. The Confederate Government could muster in Virginia only about 69.000 men to oppose nearly 200,000 Federal troops, of whom 140,000 to 150,000 were available for aggressive operations. The Confederate forces consisted of Johnston's army of 50,000 men, stretching from Winchester to Dumfries, of Magruder's force of 11,000 at Yorktown, and of Huger's troops (about 8,000) at Norfolk. Johnston, to prevent McClellan turning his position at Manassas by way of Fredericksburg or the lower Chesapeake, fell back behind the Rappahannock on March 11, and waited the development of his opponent's plans. He left Jackson in the Shenandoah Valley to watch Banks' corps and prevent the withdrawal of Federal troops from that quarter to reinforce McClellan's main body. In carrying out this purpose Jackson, with 3,000 men, attacked Shields at Kernstown March 23, and was repulsed, but he effected his object most fully, for so bold and fierce was his attack that not only was the transfer of Banks' troops stopped, but in a few days Blenker's division of 10,000 men was detached from McClellan at Alexandria and sent against Jackson, and a few days later McDowell's corps of 33,000 men, when about to join McClellan on the Peninsula was detained in front of Washington. In this way McClellan's available strength was reduced to about 100,000 men.

Next follows the skilful and masterly defense of Yorktown by Magruder and Johnston. McClellan advanced from Fort Monroe, April 4, with 58,000 men, leaving the rest to follow. Magruder checked this advance with 11,000 men disposed on a line across the Peninsula from Yorktown to the James, and for a week with this handful of men held at bay the great Federal army. At the end of that time Johnston's troops began to arrive from the Rappahannock. Johnston continued Magruder's tactics and McClellan was forced to resort to siege operations to dislodge the Confederates from a line of thirteen miles in length and manned by greatly inferior forces. The Confederates could make no adequate resistance to McClellan's siege train, and consequently when the Federal batteries were ready to open, Johnston (unexpectedly to his enemy) evacuated Yorktown, May 4. He had gained a month for the concentration of the Confederate forces.

The Confederate retreat up the Peninsula was well managed. When the Federals pressed his rear at Williamsburg, Johnston turned upon them and so punished McClellan's advance that the pursuit on that line was not resumed for several days. The movement of Federal troops to the head of York River, a day or two later, to fall on the Confederate flank, was as promptly checked. Both York and James rivers being in possession of his enemy, Johnston retired slowly across the Chickahominy and took up a position covering the north and east approaches to Richmond. McClellan advanced to the Chickahominy, and the Federal Government, yielding to his urgent appeals for reinforcements, ordered McDowell with 40,000 men to join him by way of Fredericksburg. The Confederates determined to give battle to McClellan before McDowell could join him. This design was greatly facilitated by the opportune movements of Jackson in the Valley, who, by routing Banks and advancing to the Potomac, created such a panic as to cause the recall of McDowell. Seizing this opportunity Johnston on May 31, attacked the two Federal corps, which were on the south side of the Chickahominy and defeated them. These corps were only saved from utter rout by the timely arrival of Sumner, who crossed the flooded river and hastened to their assistance in time to check Johnston's progress. Next day, the desultory fighting gave no decisive advantage to either side. The Confederates obtained little or no advantage from this battle beyond the delay and caution caused in the movements of the Federals. Gen. Johnston was disabled on May 31, and next day Gen. Lee was assigned to the command of his army.

The last period of five weeks covers Gen. Lee's operations against McClellan. Lee began to prepare at once for another attack upon the Federal army. He gathered all the troops the government could spare. He skillfully availed himself of Jackson's brilliant operations in the Shenandoah Valley, and by making a feint of reinforcing him for another advance towards Washington and then swiftly withdrawing Jackson and all his troops to Richmond, he managed to keep 60,000 Federal soldiers idle in Northern Virginia while he united Jackson's forces with his own in attacking McClellan. By this means he swelled the Confederate forces to 80,000 as against 105,000 Federals. When all was ready he concentrated two-thirds of his army against one-third of McClellan's which was north of the Chickahominy, while he left the other third to hold the lines in front of Richmond against the two-thirds of McClellan's forces which were south of that stream. He, in this way, completely defeated McClellan's right wing, and by seizing his depots and communications forced the Federal commander to seek a new base on the James River. He continued to press the retreating army, inflicting serious damage at Frazier's farm, June 30, and receiving a severe check next day at Malvern Hill, which enabled McClellan to reach the shelter of his gunboats at Westover. Though the Federal army was not destroyed, the campaign against Richmond was completely frustrated, and President Lincoln wisely withdrew McClellan once more to Alexandria.

The Army of Northern Virginia achieved most substantial success in this campaign against superior numbers and equipment, but Gen. Lee had not been able in his one month of command to mould it into that admirable and perfect instrument, which afterwards surmounted such difficulties and won such victories, as to lead a gallant foeman to declare that it "will deservedly rank as the best army which has existed on this continent."

Talk about the campaign and Gen. Lee was continued for some time after the address. In reply to questions the speaker said, that when the magnitude of results is compared with the means by which they were achieved, no officer commanding a large army on either side in the late war, is to be compared with Gen. Lee; and he thought this was rapidly becoming the opinion of those who fought against, as well as of those who fought under, the Confederate flag.

Municipal Politics in Baltimore, by JOHN C. ROSE.

[Abstract of a communication made to the University Historical and Political Science Association, January 5, 1883].

Universal manhood suffrage exists in Maryland subject to the usual exceptions in the case of convicts, aliens, and persons of unsound mind. According to the census of 1880, there were 86,841 males over 21 years of age in Baltimore. Of these, 47,169 were native white, 25,717 foreign white, and 13,455 colored.

Third parties have played little part in Baltimore politics. One of the incidents of the great railroad strike of 1877, was a fight in the streets of Baltimore between the militia and the mob, in which ten or eleven of the latter were killed. In the generally unsatisfactory condition of labor at the time, a Workingman's party was a very natural outcome. It showed a considerable degree of strength in the campaign of that year, but sank into utter insignificance afterwards. There have been two serious bolts from the dominant party, in 1875, and in 1882. In each instance the seceders formed a coalition with the Republicans, and in the latter year the coalition was successful. With this exception the Democratic party has for fifteen years been uniformly successful and has controlled every department of the city government.

On National questions the strength of the two parties is about as three to two. The Republicans can poll about 28,500 votes to 32,500 cast for the Democratic ticket. The white voters, however, are Democrats more than two to one. The colored vote is almost unanimously Republican; the great bulk of the foreign vote is Democratic.

One of the serious grounds of complaint for many years was the condition of the registration lists. There had been no new registration since 1867. The annual revisions were made by a single officer in each ward. Some of the wards then contained over 6,000 voters. The inevitable result was that the lists contained the names of many dead, removed, and disqualified people. The number of names upon the registration books was considerably greater than the entire number of males over twenty-one years of age as shown by the census. In 1882, when the Legislature made provision for a new registration, the system was unchanged. There was to be then a new registration; but after it was once made the lists were to be annually revised as heretofore. There is much reason to fear that, in a few years, things will be in as bad a condition as formerly. In a large city, where there is considerable shifting population, a registration annually renewed seems necessary to preserve the purity of the lists.

Primary elections in Baltimore as elsewhere, had, it was generally believed, ceased to meet the object of their creation; fraud and corruption not seldom controlled their results. It was felt that whatever a primary election of a voluntary political party might be in theory, in practice it constituted an important part of the machinery of government, and should therefore be regulated and controlled by law.

The Legislature in 1882 passed an Act for the regulation of the primary elections of those political parties who should place themselves under its provisions. The Act was so carelessly drawn as to be in all probability not practically enforceable. It is interesting, however, because it is the first time in this State that the law-making power has taken notice of the internal organization of political parties. The law imposes specific duties upon the city executive committee of a political party and upon the delegates to its city convention. Though legalized primaries are probably expedient, it should not be forgotten that they tend to make more rigid the party machinery and render it less susceptible of change or modification.

REPORTS OF RECENT LECTURES AND ADDRESSES.

I.—Mr. Seymour Haden's Course on Etching.

Mr. Seymour Haden, of London, the well known etcher, gave three lectures on Etching in Hopkins Hall, January 2, 3, and 4, in which he discussed the principles and practice of the art of which he is a master, and gave some historical and critical remarks on the etchers of other times. A number of gentlemen of Baltimore, owners of etchings, placed on exhibition in the parlor of the Wednesday Club some two hundred illustrations of the art, the work of Durer, Rembrandt, Jacques, Whistler, and Haden; and a reception was given to the lecturer in the exhibition room on Wednesday evening.

Bibliography.

The following reference list of books was used by Mr. Haden in connection with his lectures.

Bartsch.—Le Peintre-Graveur. T. 31. 8vo.
Blanc, Chas.—L'Œuvre complet de Rembrandt. T. 2. 8vo.
Bosse, A.—Traicté des manières de Graver, etc.
Bryan.—A Biographical and Critical Dictionary of Painters and Engravers. 2 vols. 8vo.
Duplessis, Geo.—Histoire de la Gravure. 4to. — Les Merveilles de la Gravure. 8vo.
Hamerton, P. G.—Etching and Etchers. 8vo.
Heincken (von), C. H.—Idée Générale d'une collection d'Estampes. 8vo.
Nagler, Dr. G. K.—Neues Allgemeines Künstler-Lexikon. 22 Bde. — Die Monogrammisten, etc. 4 vols. 8vo.
Ottley, W. Young.—An Inquiry into the Origin and early History of Engraving upon Copper and Wood. 2 vols. 4to.
Parthey, Gustav.—Wenzel Hollar. Beschreibendes Verzeichniss seiner Kupferstiche. 8vo.—Nachträge und Verbesserungen zum Verzeichnisse der Hollar'schen Kupferstiche. 8vo.
Passavant, J. D.—Le Peintre-Graveur. T. 6. 8vo.
Piot, Eugène.—Catalogue raisonné des Estampes gravées à l'eau-forte par Claude Gellé.
Print Collector, The.—An Introduction to the Knowledge necessary for forming a Collection of Ancient Prints. Small 4to.
Robert, Dumesnil, A. P. F.—Le Peintre-Graveur Français. T. 8. 8vo.
Seymour Haden, F.—About Etching. F. Keppel, New York. V. 1. — The Etched Work of Rembrandt. McMillan. V. 1. 8vo.
Sotheby, S.—Principia Typographia. 3 V. Folio.
Strutt, Joseph.—A Biographical Dictionary of Engravers. 2 vols. 4to.
Thausing, Moritz.—Dürer, Geschichte Seines Lebens, etc. 8vo.
Weber, Hermann.—Catalogue des Estampes Anciennes. 8vo.
Willshire, W. H.—An Introduction to the Study of Ancient Prints. V. 2. 8vo.
Wilson, Thos.—A Descriptive Catalogue of the Prints of Rembrandt. 8vo.
Zani, Abbate P.—Materiali per servire. 8vo.

II.—Mr. Story's Lecture on Michel Angelo.

Mr. William W. Story, of Rome, the author of "Roba di Roma," and well known as the sculptor by whom the statue of George Peabody was modelled for the city of London, delivered a lecture on Michel Angelo, in Hopkins Hall, January 15, at 8 p. m. The lecture was an eloquent discussion of the works of the great Italian artist, — poet, sculptor, painter, and architect, — with graphic pictures of the times in which he lived, and frequent references to his great contemporaries.

III.—Professor Corson's Course on English Verse.

Professor Hiram Corson of Cornell University, author of an "Handbook of Anglo-Saxon and English," and one of the Vice-Presidents of the Browning Society, has been delivering a public course of lectures in Hopkins Hall, January 10–31; five of which were devoted to the Æsthetics of English Verse and Prose and five to the Ideals of life and spiritual vitality exhibited in the poetry of Alfred Tennyson, Robert Browning, and Elizabeth Barrett Browning.

Two clubs for reading Browning were begun during his visit.

The scope of the lectures is indicated in the following scheme.

1. *Wednesday, January 10:* Introduction to the course on the Æsthetics of Verse; Poetic Forms employed as the conductors of the indefinable; poetic feet, metres, stanzas, etc., due to the nifying action of feeling; their enforcing and combining agencies: accent; vowel and consonantal melody.

2. *Thursday, January 11:* Enforcing and combining agencies continued: Harmony; Rhyme; Varied Metre; Exceptional Feet; analysis of the Spenserian Stanza; adaptation of the stanza to pictorial effect.

3. *Friday, January 12:* The varied toning of the Spenserian stanza as employed by other English poets, Thomson, Shenstone, Keats, Shelley, Lord Byron, etc.; stanza of Phineas Fletcher's Purple Island; of Giles Fletcher's Christ's Victory and Triumph; analysis of the stanza of Shelley's Ode to a Skylark; of the stanzas of Tennyson's In Memoriam, The Two Voices, The Palace of Art, The Daisy, To the Rev. F. D. Maurice, etc.

4. *Wednesday, January 17:* Early Blank Verse; the Earl of Surrey's; Norton's; Sackville's; Marlowe's; development attained by dramatic blank verse when Shakespeare began to write; development of Shakespeare's verse from the recitative to the spontaneous form; Characteristics of the Recitative form; of the Spontaneous form.

5. *Thursday, January 18:* The Spontaneous form continued; Shakespeare's distinctive use of Prose and Verse; the Latin and the Anglo-Saxon elements of Shakespeare's English, and the monosyllabic vocabulary, in their relations to the intellectual, the emotional, and the dramatic; general recapitulation.

6. *Friday, January 19:* Introduction to the course on poetic ideals; a poet's ethical system or philosophy of life, the true basis of poetical criticism; Matthew Arnold and Professor Edward Dowden as poetical critics; Poetry, not *explicit* but *implicit* philosophy and ethics; the poetry of the first quarter of the 19th century; Wordsworth, Byron, Shelley, Keats, and Coleridge; the influence of the French Revolution in the unfolding of the ideas which have since vitalized English poetry; Tennyson's "Poems chiefly lyrical," 1830, indicative of a new order of poetry; the ideals exhibited in his "The Poet," and "The Poet's Mind;" John Stuart Mill as a poetical critic; Tennyson's Poems, 1832; the poetical ideal embodied in "The Lady of Shalott."

7. *Wednesday, January 24:* Hawthorne, a truer Lady of Shalott than Tennyson; Tennyson's institutional creed; a reactionary product of the revolutionary spirit; his poetry the most distinct expression of the *refinements* of 19th century *English* civilization and culture; the most emphasized and most vitalized idea of his poetry: the highest order of manhood, a well poised harmoniously operating duality of the active (or intellectual or discursive) and the passive (or spiritually susceptible); the informing idea of "The Princess," "In Memoriam," and "The Idylls of the King;" the undramatic cast of Tennyson's genius; similarity of his genius to that of Spenser; it tends toward allegory and personification rather than the creation of active character; his characters exhibit but little of "the mystery of vital movement."

8. *Thursday, January 25:* Appearance of Browning's "Paracelsus" in 1836; the strong transcendental cast of genius revealed by the poem; it strikes the key-note of all his poetry; his ideals of spiritual vitality; his poem "Popularity," as imaging forth the great function of the Poet; "the value and significance of flesh," as presented in his poetry.

9. *Friday, January 26:* The spiritual and intellectual regeneration and adjustment, induced through exalted personalities, a cardinal idea in Browning's poetry; the idea leading up to Christ as a realization of the spiritual potentialities of man; Art, a representative of personality.

10. *Wednesday, January 31:* On the charges of obscurity advanced against Browning; the constitution of his favorite art-form, the Dramatic Monologue; the ideals exhibited in Mrs. Browning's "Aurora Leigh;" general recapitulation.

IV.—Professor G. S. Morris's Philosophical Course.

Professor G. S. Morris, who has given annually for several years a public course of lectures on the History of Philosophy, has this year repeated in Hopkins Hall, a course on the relation of Christianity and Philosophy, which were prepared to be given on what is known as the "Ely Foundation" in the Union Theological Seminary of New York.

A pamphlet of ten pages, too long to be reprinted here, was distributed to the audience, in order to indicate in detail the topics to be considered.

V.—Mr. Harris's Lectures on New Testament Greek.

Mr. J. Rendel Harris, late of Clare College, Cambridge (Eng.), has delivered two public courses of lectures in Hopkins Hall, to an audience largely composed of clergymen and theological students, and students of New Testament Greek. The first course of six lectures, was an Introduction to the Critical Study of the Greek Testament, and was intended to lead to the formation of a class in that study, which was subsequently organized. This course was followed by five lectures on the Epistle to Diognetus.

Subsequently in two lectures Mr. Harris described the methods he has followed and the results he has reached in a recent investigation of the structure of the earliest manuscripts of the New Testament. The substance of these two lectures may be seen by referring to the abstract (p. 61) of his paper before the Philological Association.

VI.—Mr. Uhler's Lecture on the Geology of Baltimore.

Mr. P. R. Uhler, Librarian of the Peabody Institute and President of the Maryland Academy of Sciences, delivered a lecture before the Naturalists' Field Club in Hopkins Hall, January 7, at 8 p. m., on some of the Geological Features of the Baltimore Area. His audience was mainly composed of those who are interested in the natural history of this region. He has furnished an abstract of the lecture, which is given on page 52.

THE LIBRARY OF THE LATE DR. J. C. BLUNTSCHLI

PROFESSOR OF LAW IN HEIDELBERG.

ITS PRESENTATION TO THE JOHNS HOPKINS UNIVERSITY.

The library of the late Professor Bluntschli, presented to this University by some of the German citizens of Baltimore, was formally received by the Trustees, at an assembly in Hopkins Hall, Wednesday, December 20, 1882. The hall was filled with an audience chiefly composed of the officers of the University, the students of historical and political science, and the donors of the library. Several of the judges and some members of the bar of Baltimore, had also assembled to meet the Chief Justice of the United States, present by invitation to take a part in the exercises. A portrait of Bluntschli hung over the platform, and in a convenient case were placed as a memorial of the deceased jurist, his own writings, printed and manuscript, which formed a part of the gift.

The subscription was promoted by the efficient aid of Professor C. F. Raddatz.

The names of the donors were as follows:

G. A. von Lingen,
August Vogeler,
H. H. Graue,
W. Knabe & Co.,
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In their behalf, **Col. F. Raine**, Editor of the *Deutsche Correspondent*, spoke as follows:

Mr. President and Gentlemen of the Board of Trustees:

It is with feelings of no ordinary pride that I approach you to-day as the spokesman of a number of my friends of German birth, to present to your institution of learning the library and manuscripts of one of the most celebrated law-teachers of the age, Professor Johann Caspar Bluntschli. Bluntschli died lately and when the family of the deceased offered his library for sale, it was Baltimore's good fortune to become the purchaser of the works of a man, whose fame has placed him in the foremost ranks of those noble minds who have devoted their whole lifetime to the study of law — the study of law, which, as an eminent writer of the past remarked, "relates to the interests of the human race, than which there ought to be nothing more important to man." ("*Quae pertinent ad hominum utilitatem, qua nihil homini esse debet antiquius.*")

The suggestion to make Bluntschli's library "Baltimore's own," came from gentlemen identified with your school of learning.

Credit is due to Dr. Adams as well as to Professor Raddatz. Professor Raddatz interested a number of gentlemen of German birth in the purchase and presentation of the library to the Johns Hopkins University, an institution which in its organization and work has recognized much of what German scholarship has accomplished in the past and present.

And here I may be permitted to add that a strong mixture of German idealism with American realism must in the course of time aid much in giving a loftier impulse to the development of our national character.

The appeal to purchase the library met with a ready response, the required sum was placed in the hands of responsible agents, and the books and manuscripts, embracing some 3000 volumes, have found, free of all expense, their future home in one of your buildings, which, in honor of its new occupants you have dedicated to the memory of the man whose inheritance is placed under your charge; an inheritance to attract the student and to gratify his desire for knowledge and learning, "in which we think it is honorable to excel."

Bluntschli was at the time of his death one of the great authorities of Heidelberg's law school. You can trace in his works the powerful influence of the teachings and philosophy of such renowned men as Savigny, Schleiermacher, Niebuhr, and others.

As successor to Prof. Robert von Mohl, he devoted with noble zeal all of his energies to the religious and civil emancipation of the German people, regardless of reactionary influences which too often, by the bestowal of political favors, seek to embarrass free and independent thought, yea, Prof. Bluntschli became under Germany's monarchical system more liberal than he had been under the republican rule of his Swiss fatherland.

I leave, however, a more thorough characterization of Bluntschli to abler minds, and especially to one of the gentlemen, present here to-night, who himself studied under the celebrated Professor in Heidelberg.

Boston bought the library of the German poet Freiligrath; the Cornell University, the library of the German philologist and Sanskrit scholar, Bopp; and Baltimore adds to-day to her treasures the works of Bluntschli, who, though born in Switzerland, was eminently German in his ideas. Rich in all of the noble gifts of nature he was most distinguished by the rarest — clear judgment and faithful interpretation of the law.

In thus dedicating Bluntschli's library to the Johns Hopkins University, I express the hope that the volumes, now placed upon your shelves, may prove to the students of history and law an incentive to further research, a greeting from the "Vaterland" to the last home of the Teutons.

I congratulate both donors and donees, the first for having expressed in a practical manner their appreciation of this noble institute of learning, the latter for becoming custodians of a library which must prove of great benefit to professors and students in acquiring "sacred, substantial, never failing bliss."

Hon. George W. Dobbin, President of the Board of Trustees, made the following reply:

Col. Raine and Gentlemen:

The Trustees of the Johns Hopkins University, and the body of learned men who conduct its teaching, accept this liberal gift of the late Professor Bluntschli's library with grateful thanks.

Though not long in existence, the University has been the recipient of kind favors, in the form of books, at the hands of its friends, but no gift has approached the importance of that which they now owe to you. Great as is its value considered in the light of the good it will achieve, it has to us a significance beyond that, the worth of which it is difficult to estimate. It is a token of your approval of the course of the institution, and an earnest that it may count you among its steadfast friends. Knowing you to be representative men of that great body of American citizens who, by immigration and descent, have added to our population an element second to none other, we appreciate your approval as of priceless value.

Indeed, our relations to your fatherland in an educational aspect, are of the closest kind; for what problem in science,—what question in literature,—what disputed point in history, can be considered as satisfactorily examined before the results of German research have been availed of. Our own estimate of the excellence of German scholarship and University teaching is attested by the fact that we have profitably borrowed many of their methods, and by the further fact that no scholar presents himself to us for our instruction as better accredited than one who brings with him the diploma of a German University.

In another aspect your gift is most noteworthy. It is a mistake to suppose that any institution whose mission is to attract young enquiring minds within its walls, and by the instruction and instrumental means afforded there to lead them to the eminence of the highest scholarship, can succeed without the encouraging and fostering care of the people among whom it is placed. This sympathy and this help must come not only in the form of verbal approval, but it must be attested by other more substantial witnesses. In the history of other kindred institutions we know that libraries have been founded,—chairs have been endowed,—buildings have been erected,—thus commemorative of names that will never be forgotten. We have no reason to suppose that prosperous Baltimore will, in the progress of time, be behind in this race of well doing; and if we needed confirmatory assurance of this fact, we might well find it in the recent gift, by a liberal citizen to the people, of a free public library. Thus it is that names which, however estimable in private life would be known only to the generation in which they lived, come to be perpetuated in association with instrumentalities which will be active for good through all future time.

In this direction of enlightened well doing, in our career, you have the merit of being the pioneers, and you have the proud honor of having transferred and commemorated, by an enduring memorial, the fame of Bluntschli, already illustrious, to a new sphere of culture where it will never die.

In still another aspect we have reason to thank you for this gift, by which you have bestowed upon us a library the like of which, in its wealth of history and political philosophy, is not to be found elsewhere. To no nation more than to us, as a self-governing people, is the study of these subjects more necessary and more profitable.

Need we assure you, Gentlemen, that your generous gift shall be industriously and profitably used? We are glad to believe that we have already in our teaching staff, young, vigorous, and active minds, who received their lessons from the lips of Bluntschli himself, and who have already shown that they are the worthy scholars of a great master. To them, and to others who may from time to time, in the growth of the University, are the Geschichtsfreund, Schenkel's Allgemeine Kirchliche Zeitschrift, the Kritische Vierteljahrschrift für Gesetzgebung und Rechtswissenschaft, the Revue Historique du Droit Francais, Revue de Législation, Southern Law Review, and various other "Revues" and "Zeitschriften."

But, after all, it is not too much to say that the mass of pamphlets, at first arrival *rudis indigestaque moles*, but now in complete order and nearly ready for use, is the really invaluable part of the collection. The books will be more used, it is true. But most of these could probably, even if at high cost, be purchased now; pamphlets, however, disappear rapidly, and a few years after publication are often absolutely not to be obtained.

Naturally, it is in the department of law that the pamphlets are most numerous, numbering probably six hundred, many of which will bear on institutional studies. In international law and politics there are about two hundred, embracing under the one head such publications as those of and about the Institut de Droit International, the Geneva and Brussels conferences, on war, on arbitration and much else; under the other, the Eastern Question, the Schleswig-Holstein succession, the Alabama awards, etc. Political science is equally well represented. The pamphlets on historical matters and on political questions of the day number nearly as many; those on economics as many more. Among the former is one of rather curious interest. It is an anonymous pamphlet entitled La Question Monarchique en France et en Europe. On the second page of the cover is the inscription, "A Son Altesse Le Prince de Bismarck Chancelier de l'Empire d'Allemagne, De la part de l'auteur, Baron de Krüdner." Below is a pencilled note by Bluntschli, as follows; "Von Baron Jomini erhalten, obwohl ich denselben auf die Dedication aufmerksam machte, die er als nicht gültig erklärte." The pamphlets on the relations of church and state are nearly as numerous as these last; Dr. Bluntschli took great interest in religious and ecclesiastical questions, and especially in those brought forward as the result of the Vatican Council. The collection also, naturally, includes many memoirs and brief notices of famous scholars who had been Bluntschli's contemporaries, teachers or friends, but passed away before the close of his long life—of Bunsen, Von Döllmann, Humboldt, Lawrence, Mittermaier, Von Mohl, Padelletti, Savigny, Schleiermacher, Trendelenburg, Vangerow, Wächter and others less distinguished. Presentation copies of pamphlets with the autographs of distinguished authors abound.

Among the legal pamphlets is one which, though very likely not of great value from the point of view of the jurist, is in another respect, the most interesting of all. It is Goethe's doctoral thesis, published at Strassburg in 1771, the first of the studies so often interrupted by those visits to Sesenheim, which have since become so famous. The title is this: "Positiones juris quas auspice Deo inclyti jureconsultorum ordinis consensu pro licentia summos in utroque jure honores rite consequendi in Alma Argentinensi die VI. Augusti MDCCLXXI. H. Q. L. C. publice defendet Joannes Wolfgang Goethe, Moeno-Francofurtensis."

If the pamphlets could hardly be replaced, the manuscripts and notebooks of Dr. Bluntschli are of unique value, and deserve a few words more than the brief mention above. The kindness of his family in adding them to the collection is highly appreciated, and it is felt that they augment greatly its value and interest, especially in making it a more complete memorial of the great jurist himself.

RECENT ACCESSIONS TO THE LIBRARIES OF BALTIMORE.

LIBRARY OF THE PEABODY INSTITUTE.

The more important recent additions to this library have been as follows:

In SCIENCE:
- Fauna and Flora of the Gulf of Naples, from the Zoölogical Station (Dohrn's) at that place.*
- Scientific results of the Challenger Voyage, Vols. 4, 5.
- Geological Chart of Switzerland, in numerous topographical maps, with volumes of descriptive text.
- Martini und Chemnitz, Conchylien-Cabinet, with a great number of colored plates.
- Ray Society Publications, including Monographs of British Spongiadae, British Aphides, and Phytophagous Hymenoptera.

In LITERATURE:
- Andreini's L'Adamo, a curious, rare old book of 1617, written in dramatic style, illustrated by engravings of scenes imagined to be connected with Adam and Eve, and which is said to have suggested to Milton some of the ideas embodied in his Paradise Lost.
- Grosart's careful reprint of Edmund Spenser's Works.
- Publications of the Chaucer, Spenser, and New Shakspere Societies.*
- The English Scholar's Library. (Auber's).
- Huth Library of Old English Poetry and Prose, edited by Grosart.
- Legonidec's large Breton-Français Dictionary.
- Biblioteca delle tradizioni popolari Siciliane, in 12 vols.
- Ogilvy's translation into English of Homer's Iliad and Odyssey, large folio.

In other departments may be mentioned:
- Archaeological Survey of India.
- Index Society's Publications.*
- Cesnola's Salaminia.
- Palaeographical Society's facsimiles of Oriental and other Manuscripts.*
- Yriarte's Florence.
- Duppa's Lotus of the Ancients.
- Droysen's Geschichte der Preussischen Politik.
- Publicationen aus den K. Preussischen Staatsarchiven.

January 16, 1883. P. R. UHLER, *Librarian.*

LIBRARY OF THE JOHNS HOPKINS UNIVERSITY.

Among the late additions are:

- The Library of Dr. J. C. Bluntschli, described on another page of this *Circular.*
- A large collection of Public Documents from Hon. A. P. Gorman, U. S. Senator from Maryland.
- An extended collection of Publications, Maps, etc., from the U. S. Signal Service.
- Crelle's Journal f. reine u. angew. mathematik. (*Complete*).
- Archiv f. Anatomie u. Physiologie. (*Complete*).
- Bibliotheca Indica. (*Complete*). From the Asiatic Society of Calcutta.
- Panini. Edn. of Böhtlingk with Benfey's ms. notes.
- Amantadeva Sanskarakanstubha.
- Narayana Bhatta.
- Robinson's Persian Poetry. (Printed for private circulation).
- Norske Nordhavs Expedition. (Publications of the Norwegian Arctic Expedition, 1876-78. In Swedish and English).
- Flora Littoralis Norvegiae, 2 vols. folio with plates. From the Museum of Bergen, Norway.
- Peters. Celestial Charts. 1-20.
- Histoire Naturelle de l'Empire Chinois. I.
- History of the Great Trigonometrical Survey of India.
- Folk-Lore Society's Publications.
- Dialect Society's Publications.
- Bentley's edition of the Paradise Lost.
- Hofmeister. Germination of Higher Confervae.
- Frazer. Memoire sur la Géologie de la Partie Sud-Est de la Pennsylvanie.
- Transactions, &c., of the Academies and learned institutions below named, most of them now first received; a few in continuation of former receipts.
  - Asiatic Society of Calcutta.
  - Royal Academy of Berlin.
  - Academy of Sciences of Brussels.
  - University of Christiania.
  - Essex Institute Historical Collections.
  - Seismological Society of Japan.
  - Royal Society of London.
  - Society of Telegraph Engineers of London.
  - Owens College (Victoria Univ.), Manchester, England.
  - Central Observatory of Mexico.
  - Lombard Institute of Milan.
  - New Zealand Institute.
  - Linnean Society of New York.
  - Zoological Station (Dohrn's) at Naples.
  - Imperial Observatory of Rio de Janeiro.
  - Southern Historical Society Papers.
  - Swiss Society of Natural Sciences.
  - University of Tokio, Science Department.
  - Academy of the Lincei of Rome.
  - Royal Academy of Turin.
  - Royal Academy of Vienna.

The following accessions to the list of current scientific periodicals have recently been made:
- Acta Mathematica. Stockholm.
- Archives Italiennes de Biologie. Turin.
- L'Astronomie. Paris.
- Canadian Naturalist. Montreal.
- Education, and Journal of Education. Boston.
- The Electrician. New York.
- Gazzetta Chimica Italiana. Palermo.
- Jornal de Sciencias Mathematicas. Coimbra, Portugal.
- Journal of Education. London.
- Moniteur Scientifique. Paris.
- Der Naturforscher. Berlin.
- Revista Cientifica Mexicana. Mexico.
- Scientific Roll. London.

The works marked * in the Peabody list, are also in the Johns Hopkins University Library.

January 20, 1883. WM. HAND BROWNE, *Librarian.*

HOPKINS HALL LECTURES.

IX.

ANGLO-SAXON POETRY.

Professor James A. Harrison, of Washington and Lee University. Ten lectures. Mondays, Wednesdays, and Fridays, February 12 to March 2.

Dates, Subjects, and Reference Lists.

I. *Monday, February 12.* The German Fatherland. Characteristic features of the Germanic group of languages. Historical conditions under which Anglo-Saxon Poetry grew up. The period 449–1066. Political, social, religious influences contributing to the birth of the state and the nurture of literature.

Arnold's Deutsche Urzeit, 1881 (H); Kauffmann's Deutsche Geschichte, (1880); Germania and Agricola of Tacitus, (P, H); Dahn's works on early German History, (H); Elton's Origins of English History, (P, H); Turner's and Lappenberg's Histories of the Anglo-Saxons, (P, H); Kemble's Saxons in England, (P, H); Vol. I of Freeman's Norman Conquest, (P, H); Stubbs's Constitutional History, (P, H); Green's Making of England, (H), and History, Vol. I, (P, H); Gidley's Bede's Ecclesiastical History, with J. E. B. Mayor's edition; Werner's Baeda's Leben; Bohn's one volume ed. of the Chronicles of Gildas, (P); Nennius, (P); Ethelweard, (P); Geoffrey of Monmouth, (P); Richard of Cirencester, (P); and Asser's Life of Aelfred, (P); Grant Allen's Anglo-Saxon Britain, (H); Earle's Anglo Saxon Chronicles, (H).

II. *Wednesday, February 14.* Study of Anglo-Saxon in England. Remains of Anglo-Saxon verse. The MSS. and codices. Runes. Alliterative poetry. The Traveller's Tale. The minstrel's profession and its contribution to the growth of poetry. The rise of Hymnic Poetry and the growth of the Epos.

Conybeare's Illustrations, (P, H); Ten Brink's Geschichte der Englischen Literatur, (P, H); Morley's English Writers, Vol. I. Part 1, (P, H); Warton's History of English Poetry, 1871, Vol. II, (P, H); Taine's English Literature, (P, H); Schipper's Englische Metrik, 1882, (H).

III. *Friday, February 16.* The Epic in England. Theories of the composition of Beówulf. Origin of the poem. Analysis of Beówulf. Editions and translations.

Ten Brink's Geschichte, (P, H); Thorpe's and Kemble's Beówulf, (P, H); Lumsden's (H), Arnold's (H), Garnett's (H), (the best) translations.

IV. *Monday, February 19.* Old Teutonic life in Beówulf. Geographical, mythical, and historical data in the poem.

F. A. March, Proceedings of Am. Phil. Assoc., 1882, (P, H); Ebert's Zeits. IV, for Grein's article, (H); Gummere's Anglo Saxon Metaphor, 1881; Haupt's Zeits. V-XIV, (H), contains important articles; W. Höpfner u. Zacher's Zeits. II-IV, (H), Germania, I-XIII, (H); Anglia, IV, (for discussion of the translations of Beówulf,) (H), Garnett's Bibliography of Beówulf, (H).

V. *Wednesday, February 21.* The story of "Caedmon." Growth of epic style. Current views in reference to Caedmon's authorship of the poems in the Junian MSS. Analysis of the Genesis.

Thorpe's Caedmon's Metrical Paraphrase, (P); Bede's Ecclesiastical History, chap. IV, (P); Turner's Anglo-Saxons, Vol. III, (P, H); Wright's Biographia Brit. Literaria, (P, H); Bouterwek's Caedmon, (P, H); Conybeare's Illustrations, (P, H); Morley's Eng. Writers, Vol. I, part 1, (H); Ebert in Anglia, V, (H); Watson's Caedmon; Skeat's Guest's History of English Rhythms, (P, H).

VI. *Friday, February 23.* The Exodus, Daniel, Azarias, of "Caedmon." The poem of Judith. Theories connected with Caedmon's alleged authorship continued. Editions and translations. "Caedmon" and Milton.

Essays and Dissertations on Caedmon by Wülcker (Anglia, IV), (H); Götzinger, (H); Greverus, Balg, Sandras, (P, H); Ten Brink's Geschichte, (P, H).

VII. *Monday, February 26.* Cynewulf. The third great Anglo-Saxon poet. The "romance" of Cynewulf. Poetry of the Sacred Legend. The Riddles of the Exeter Book. The Ruthwell Cross.

Thorpe's Codex Exoniensis, (P, H); Essays on Cynewulf by Wülcker, (H), Dietrich, (H), Leo, (H), Ebert, (H); Ten Brink's Geschichte, (P, H).

VIII. *Wednesday, February 28.* Cynewulf's Christ, Juliana, and Elene. Guthlac and Andreas. Physiologus. Phoenix.

Grimm's Cynewulf's Andreas und Elene, (P, H); Zupitza's Elene, (H); Horstmann's Altenglische Legenden, II, (H); Essays in Anglia, by Gäbler, (H); Charitius, Fritzsche; Thorpe's Codex Exoniensis, (P, H); Morley, Wright's Biographia, (P, H).

IX. *Thursday, March 1.* Minor Anglo-Saxon poetry. Deor's Complaint. Waldere. The Wanderer. The Sea-farer. The Ruin. Gnomic Verse. The Various Gifts of Men. The Various Fortunes of Men. A Father's Counsel. The Runic Song. Spells and Incantations. Religious and Didactic Verse. Aelfred's Boethius.

Wülcker's Kleinere Angelsächsische Dichtungen, 1882, for texts; Thorpe's Codex Exoniensis, (P, H), for translations; Conybeare, (P); Sweet (Warton, II), (H); Morley I, Part I, for translations and discussions, (P); Hartmann's (Anglia, V) Essay on Aelfred's Boethius, (H); Pauli's and Weiss's Lives of Aelfred, (P, H); Fox's Boethius, (P, H).

X. *Friday, March 2.* Minor poetry continued. Satan. Solomon and Saturn. Menology. Dialogue between the Soul and the Body. Fates of the Apostles. The Riming Song. Revival of the Anglo-Saxon Battle-poetry. The Fate of Byrhtnoth. The six poems of the Anglo-Saxon Chronicle (Battles of Brunanburh, &c.). The poet Aelfric. Conclusion.

Wülcker for texts, (H); Thorpe's Codex Exoniensis (P, H) and Kemble's Codex Vercellensis, (P); Conybeare, (P); Sweet (Warton, II), (P, H); Turner, Vol. III, (P, H); Freeman's Norman Conquest, I, (P. H); Earle's Anglo-Saxon Chronicles (H); Dietrich's Essay on Aelfric.

Works for General Reference.

Grein's Bibliothek der Angelsächsischen Poesie (P, H) contains nearly complete Anglo-Saxon texts, with German translations, of all the poems discussed in the lectures; add Holder's (H) and Wülcker's (P, H) exact reprints of Beówulf; for foundations of Cynewulf's legends see the Acta Sanctorum, (P); Metcalfe's Englishman and Scandinavian (H), compares Anglo-Saxon poetry with Icelandic; Laing's Heimskringla (P); Lettsom's translation of Nibelungen Song; Simrock's, (P, H), and Wenzel's (H) Edda, (German translations).

Note.—Books marked H are in the Johns Hopkins University Library; P, in the Peabody Institute Library.

Slight deviations from the printed plan of the lectures may be expected.

X.

PEDAGOGY.

Professor G. Stanley Hall, Ph.D., Lecturer on Psychology. Eight lectures on the Principles and Methods of Intellectual Training, Tuesdays, February 20 to April 10.

I. *Tuesday, February 20.* Present educational needs and interest. The methods of Pedagogy illustrated by a systematic study of children in the Boston public schools.

II. *Tuesday, February 27.* Educational literature and history. How to study its problems. The training of teachers.

III. *Tuesday, March 6.* Ziller's "concentration series," illustrated in reading, writing, and literature.

IV. *Tuesday, March 13.* The cultivation of the memory, and the development of morbid self-consciousness in schools and colleges.

V. *Tuesday, March 20.* The training of the attention and the will.

VI. *Tuesday, March 27.* The education of the eye, ear, and hand. Elementary scientific teaching.

VII. *Tuesday, April 3.* The study of language. The German gymnasium.

VIII. *Tuesday, April 10.* Training in good habits, manners, and sentiments.

XI.

THE RELATIONS OF LITERATURE TO MODERN SOCIETY.

Mr. George W. Cable, of New Orleans. Six lectures.

I. *Monday, March 5.* The necessities from which Literature springs.

II. *Wednesday, March 7.* Its influence on Man's public life.

III. *Friday, March 9.* Its operation and effects in the private life.

IV. *Monday, March 12.* The attitudes of modern society toward literature.

V. *Wednesday, March 14.* The reciprocal duties of literature and society.

VI. *Friday, March 16.* The literary art and artist.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

January 3.—Professor Sylvester in the chair. Twenty-four members present.
Papers read:
On the Graphical Proof of Certain Algebraical Problems, by J. J. SYLVESTER. (*Abstract on p.* 43).
Preliminary Notice of a New Determination of the Value of the Ohm, by A. L. KIMBALL. (*Abstract on p.* 54).

Philological Association.

January 5.—Professor Gildersleeve in the chair. Thirty-five members present.
Papers read:
On the Importance of Latin Glossaries with special reference to Codex Sangallensis 912, Saec. VII–VIII, by M. WARREN. (*Abstract on p.* 51).
On New Testament Autographs, by J. R. HARRIS. (*Abstract on p.* 51).
On Arthur C. Burnell and the Talavakāra Brāhmaṇa, by M. BLOOMFIELD. (*Abstract on p.* 51).

Historical and Political Science Association.

December 8.—President Gilman in the chair. Thirty-two persons present.
Paper read:
Recollections of Madison and other American Statesmen, by JOHN H. B. LATROBE, President of the Maryland Historical Society. (*Abstract on p.* 55).

December 15.—Dr. H. B. Adams in the chair. Twenty-nine persons present.
Paper read:
The Peninsula Campaign of 1862, by WILLIAM ALLAN. (*Abstract on p.* 55).

January 5.—Dr. H. B. Adams in the chair. Twenty-seven persons present.
Papers read:
Municipal Politics in Baltimore, by J. C. ROSE. (*Abstract on p.* 56).
Account of the Contents of the Bluntschli Library, by J. F. JAMESON. (*Abstract on p.* 61).

January 12.—Dr. H. B. Adams in the chair. Twenty-three persons present.
Papers read:
Plymouth Rock Restored, (Second Article), by H. B. ADAMS. (*Printed in the Magazine of American History, January*, 1883).
Money and its Functions, by DR. R. T. ELY. (*Abstract on p.* 57. *Printed in full in the Bankers' Magazine, January*, 1883).

January 19.—Dr. H. B. Adams in the chair. Thirty-three persons present.
Papers read:
The University of Oxford and the Oxford Humanists, by C. H. SHINN. (*To be published in the Overland Monthly*).
Town and Gown, by W. T. CROASDALE. (*Printed in "The Day," January* 22, 1883. *Abstract on p.* 57).
Note on the Brief of Charles J. M. Gwinn in the Case of Turner vs. State of Maryland, by H. B. ADAMS. (*Abstract on p.* 57).
Remarks on Charleston, S. C., as a field for historical investigation, by HENRY E. SHEPHERD, President of the College of the City of Charleston.

Mathematical Society.

January 17.—Professor Sylvester in the chair. Sixteen members present.
Papers read:
On the Numbers $a_{n,m}$, which occur in Connection with the Proof of Staudt's Theorem concerning Bernoulli's Numbers, by G. S. ELY. (*Abstract on p.* 47).
On Measurement in Non-Euclidean Geometry, by W. E. STORY. (*Abstract on p.* 46).
On the Equation of a Curve referred to a Maximum Inscribed Triangle, by A. S. HATHAWAY. (*Abstract on p.* 48).
Proof of a well-known Development of a Continued Product in a Series, by J. J. SYLVESTER. (*Abstract on p.* 46).
On the Number of Fractions in their Lowest Terms, whose Numerators and Denominators are Limited not to exceed a Certain Number, by J. J. SYLVESTER. (*Abstract on p.* 44).

Metaphysical Club.

January 16.—Professor G. S. Morris in the chair. Sixteen members present.
Papers read:
The Logical Problem, by J. JASTROW.
Henry James, by G. S. MORRIS.

Naturalists' Field Club.

January 7.—Dr. W. T. Sedgwick in the chair.
MR. P. R. UHLER, President of the Maryland Academy of Sciences, delivered a lecture upon the Geology of the Surface Features of the Baltimore Area. (*Abstract on p.* 52).

Maryland Historical Society.

January 8.—The President, Hon. J. H. B. Latrobe, in the chair.
Paper read:
On the Foundation of Maryland and the Origin of the Act concerning Religion, by BRADLEY T. JOHNSON.

Publications Issued under the Auspices of the Johns Hopkins University.

I.—AMERICAN JOURNAL OF MATHEMATICS.

Professor J. J. Sylvester, F. R. S., D. C. L., Editor. Quarto. Quarterly. Subscription, $5 per year. Vol. i., 1878, 388 pp. Vol. ii., 1879, 408 pp. Vol. iii., 1880, 398 pp. Vol. iv., 1881, 384 pp. Vol. v., 1882.

II.—AMERICAN CHEMICAL JOURNAL.

Professor I. Remsen, M. D., Ph. D., Editor. Octavo. Bi-monthly. Subscription, $3 per year. Vol. i., 1879, 460 pp. Vol. ii., 1880, 448 pp. Vol. iii., 1881, 462 pp. Vol. iv., 1882.

III.—THE AMERICAN JOURNAL OF PHILOLOGY.

Professor B. L. Gildersleeve, Ph. D., LL. D., Editor. Octavo. Quarterly. Subscription, $3 per year. Vol. i., 1880, 535 pp. Vol. ii., 1881, 570 pp. Vol. iii., 1882.

IV.—STUDIES FROM THE BIOLOGICAL LABORATORY.

Including the Chesapeake Zoological Laboratory.

Professor H. N. Martin, M. A., D. Sc., M. D., Editor, and W. K. Brooks, Ph. D., Associate Editor. Octavo. Subscription, $5 per volume. Vol. i., 1879-80, 500 pp., 40 plates. Vol. ii., 1881–83.

As a considerable portion of the contents of a volume of the Studies from the Biological Laboratory frequently consists of reprints from the Journal of Physiology, subscribers to the latter will be charged only $3.50 for each volume of the "Studies."

V.—CONTRIBUTIONS TO LOGIC.

Professor C. S. Peirce, Editor. A volume of LOGICAL CONTRIBUTIONS, by members of the Johns Hopkins University. (Little, Brown & Co., Boston, 1883).

Contents: The logic of the Epicureans, by Allan Marquand; On the algebra of logic, by Miss Ladd; On the algebra of logic, by O. H. Mitchell; On relative numbers, by B. I. Gilman; On probable inference, by C. S. Peirce.

VI.—HISTORICAL AND POLITICAL STUDIES.

H. B. Adams, Ph. D., Editor. The publication of a series of University Studies in American Institutional History, (with special reference to the local government and economics of individual States of the Atlantic Seaboard and of the Northwest), is now in progress. A list of the earlier numbers of the series will be sent on application. Subscription, $3 per volume of twelve numbers, comprising from 300 to 400 pages.

THE JOURNAL OF PHYSIOLOGY.

Michael Foster, M. D., F. R. S., Cambridge, England, Editor in Chief, Octavo Six parts will form a volume of about 500 pp. Subscription $5 per volume. Vol. i., 626 pp., 17 plates. Vol. ii., 596 pp., 18 plates. Vol. iii. in progress.

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The OFFICIAL PUBLICATIONS of the University are:

I. An ANNUAL REPORT presented by the President to the Board Trustees, reviewing the operations of the University during the past academic year.

II. The UNIVERSITY CIRCULARS, issued from time to time, giving current information as to the work here in progress or proposed.

III. A REGISTER, giving the list of officers, academic staff, and students, and containing detailed statements as to the regulations and work of the University, published near the close of each academic year.

Announcements of proposed lectures, courses of instruction, etc., appear in the University Circulars, or are separately issued from time to time.

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The Johns Hopkins University Circulars are printed by Messrs. JOHN MURPHY & CO., 182 West Baltimore Street, Baltimore, from whom single copies may be obtained. They may also be procured, as soon as published, from Messrs. CUSHINGS & BAILEY, No. 262 West Baltimore Street, Baltimore.

SCIENTIFIC NOTES

On the work of members of this University in Mathematics, Physics, Chemistry, Biology, Ancient and Modern Languages, History, Political Science, Psychology, Ethics, and Logic.

NOTES IN PHILOLOGY.

On the General Theory of Greek Accentuation, by M. BLOOMFIELD.

[Abstract of a paper read at the meeting of the University Philological Association, February 2, 1883].

This paper contains a series of historical and critical remarks introductory to a comparative study of Greek accentuation and deals with its subject under six heads.

I. In an introductory chapter the phonetic bearings of the subject are discussed. The main points which are emphasized are first: the distinction between sentence-accent, word-accent, and syllable-accent, and the importance of each of these three in the scientific treatment of the accent of any language. It is shown that sentence-accent especially is just at this time gaining a peculiarly important place in the study of Indo-European grammar. Secondly, it is pointed out how important is the distinction between the chief or summit-accent of sentences and words and their general accentuation, which treats with equal interest the history of pitch and stress in every word of a sentence, and in every syllable of a word.

II. The second chapter is devoted to a discussion of the accentual phenomena of the most important languages of the Indo-European family, and the attempts which have been made, to establish upon the basis of the separate languages a picture of the proethnic Indo-European parent language itself. The views of Benloew and Bopp are subjected to especial criticism, others are passed over lightly. Furthermore the attempt is made to establish certain fundamental principles from which the discussion of the accentuation of any single language must start. Prominent among these is the statement that accentual change must be due to and governed by phonetic law, as much as any other process of change in language. Therefore it must be shown by what laws the peculiar features of Greek accent arose out of the reconstructed Indo-European accentuation. No explanation of the facts of Greek accent which does not connect these with the facts of Indo-European accentuation can be worth much.

III. The third section is devoted to a formulation of the prominent laws of Greek accent within the language itself. Greek accent is largely archaic, *i. e.* it has preserved the prehistoric accent of the parent language; still more largely however the old accentuation has been overrun by a new principle, the "recessive accentuation." It is shown that the well-known laws of this recession are in striking accord with the Greek laws of enclisis, and the ground is taken that this similarity of the laws for enclisis ought to be duly considered in any attempt to explain recessive accentuation.

IV. In this chapter the discussion turns more especially to the Greek. After a review of the literature of the subject the more prominent explanations of Greek accent are considered. After disposing of Göttling's theories, weak even in their day, the very interesting work done by Franz Misteli and James Hadley is discussed and criticized. It is shown how their theory of Greek accentuation, ingenious as it is, fails to hold its ground, when looked at closely. The weakest point in their explanation of the Greek recessive accentuation is this, that they fail to recognize the fact that this accentuation is indigenous with the verb and with the verb only; its extension over other parts of speech is secondary and late.

V. As the theory of Misteli and Hadley draws in the three-syllable accentuation of the Latin a short chapter is devoted to disproving its validity on Latin ground as well as on Greek.

VI. In the last chapter, Jacob Wackernagel's theory of the Greek recessive accentuation is presented and supported. Wackernagel has shown that the Greek recessive accent of the finite forms of the verb is a *substitute for enclisis*. This enclisis was in Indo-European times a quality of the finite verb only in paratactic clauses; in Greek it has become extended to the finite verbs whether in paratactic or hypotactic construction by analogy. Only a few isolated forms of the finite verb have succeeded in preserving orthotonesis by their peculiar character; the entire finite verb has the accentuation of enclitics, which receive an accent, when the word exceeds two syllables or three *moras* according to the laws of "recessive" accentuation.

On the Normal Forms of Early Epistles, by J. RENDEL HARRIS.

[Abstract of a paper read at the meeting of the University Philological Association, February 2, 1883].

The paper assumes the existence of pattern lines of writing among the ancients, viz: the hexameter line and the iambic trimeter, or some submultiple of one of these. From the fact that paper was sold in given sizes, it is highly probable that not only had the lines a model number of syllables, but that the pages had a fixed number of lines.

If this were the case it ought to be possible to determine the size of this normal page of writing from an examination of a given collection of letters. The method adopted was as follows: A collection of letters being taken, the frequency with which letters of any assumed size recurred was tabulated, and it was shown that this frequency must be a maximum for letters just under an integral number of pages of the author, and a minimum when the letter was just over an integral number; because there is a tendency, other things being equal, to finish a letter rather at the bottom of a page than at the top.

The method was first applied to Pliny's letters, with the following result: the normal page of Pliny's writing is between 7.4 and 7.6 lines of the Teubner edition, and represents 20 half-hexameters. Traces were also found of the existence of a smaller page; and the results were applied to the criticism of some lines in Pliny, IV. 11. From this result it followed at once that the separate books of Pliny's letters were, in reality, rolls of 100 sheets apiece.

The method was then applied to the letters of Cicero, with the following results; the commoner type is a letter, a single page of which is represented by 11 Teubner-lines or near it; *i. e.* by 28 half-hexameters, or twice what was designated in a previous paper as a V-page.

A smaller page was also found in not a few instances.

The results were applied to show the manner in which the letters had been reduced into books. Some tests were then applied to the result from the Epistles themselves: such as in Ep. ad Familiares, Book XI. 25, "Non imitor *Λακωνισμὸν* tuum; altera iam pagella procedit," was shown to be the bottom of the first page.

Participial Periphrases in Attic Prose, by W. J. ALEXANDER.

[Abstract of a paper read at the meeting of the University Philological Association, February 2, 1883].

The periphrases treated were those of the present participle with *εἶναι* or *γίγνεσθαι* in the Attic Orators, Plato and Thucydides. Those occurrences in which the participle precedes were first considered, inasmuch as they contain the copular verb in its natural position. It was maintained that the conception which lies at the basis of the verb is that of an activity, and that a participle, when used as such, is as truly a verb as an indicative, and hence presents a definite action to the mind, and predicates. The participle may, however, assume the place and functions of an adjective but by so doing loses the essentials of a verb. The periphrasis under examination is a case of this kind, and in virtue of the transfer of a participle to an adjective, has a function of its own and is differentiated from the corresponding finite forms. It expresses a permanent quality or characteristic without reference to definite acts. (For a clear exhibit of the meaning of the periphrasis see Pl. Euthyph. 9 E. seq., where the argument hinges on the difference between finite and periphrastic forms).

Studies in Pindaric Syntax, by B. L. GILDERSLEEVE.

[Abstract of a paper in the *American Journal of Philology, No.* 12].

The first of these studies (The Conditional Sentence in Pindar) is based on a paper read before the Johns Hopkins Philological Association (February meeting, 1882), and a summary of it will be found in the *University Circular* for May, 1882, p. 205. The second treats of AN and KEN in Pindar. The following table shows the number and character of the occurrences:

KEN		AN	
Mood and Tense:		Mood and Tense:	
Indic. Imperf.	1	Ind. Aor.	3 (2)
Aor.	8	Fut.	1
Opt. Pres.	8	Opt. Pres.	4 (3)
Aor.	11	Aor.	6
Subj. Aor.	2	Subj. Pres.	6
Inf. Pres.	1	Aor.	10
Aor.	1	Pres. or Aor. according to reading	2
Fut.	1		
	33		32 (30)
Character:		Character:	
Formulated conditionals	8	Formulated conditional	1 (0)
Half formulated	6	Virtual condition	4 (3)
Involved	9	Potential (positive)	4
Relative conditional (generic)	1	(negative or equivalent)	4
With subj. as exact future	1		
Potential	8	Relative (generic)	5
		Temporal (whenever)	
	33	Pres. of a single time, definite person	3
		general of a definite person	2
		person and time general	2
		Aor. of a single time, definite person	2
		general of a definite person	2
		person and time general	2
		Doubtful (general)	1
			32 (30)

A comparison of these tables shows that ἂν has gained on κέν, if we take Homer as a standard. In the Iliad κέν stands to ἂν as 4:1. In the formulated condition (with εἰ) ἂν is not used by Pindar either in protasis or apodosis, and even in so-called virtual conditions ἂν is sparingly employed.

French Syntax as Affected by the Cultivation of Style, by P. B. MARCOU.

[Abstract of a paper read at the meeting of the University Philological Association, March 2, 1883].

An ability to point out the peculiarities of the syntax of a writer or school of writers, is an almost indispensable prerequisite for a true criticism of that writer or school of writers. The very great attention paid to style by French writers, both classic and modern, the keen sense for beauty of expression enjoyed by the whole nation, and the nature of French education whose main aim is the cultivation of a good French style, make it extremely probable that a comparison of the syntax of modern French with the syntax of classic French authors will reveal certain tendencies produced by this persistent cultivation of form in writing. Two qualities which French writers seek to impart to their style are perfect clearness and smoothness, and a liveness or unexpectedness of expression such as may keep the reader's fancy constantly on the alert. The effort to produce the first quality has resulted in a very marked shortening of the length of French sentences. Thus the average number of verbs per sentence in one hundred consecutive Montaigne sentences (the number of verbs in a sentence being taken as a rough indication of its length) is 6.02; in Fénelon, who comes about a century later, this average is 4.48; finally, coming to our time, in Sainte-Beuve it is 3.95 and in Alphonse Daudet, 3.38. Increase in smoothness is shown by a tendency in the more recent writers to make the length of all their sentences approximate much nearer to the length of their average sentence than is the case with the earlier writers.

The effort to produce the second quality of style mentioned has resulted in a more and more nice discrimination between the preposition and the postposition of a certain class of attributive adjectives denoting mostly moral qualities. On the one hand, through a sort of attraction towards the French usage with regard to the majority of adjectives, these adjectives denoting moral qualities have been put more and more frequently after their nouns; on the other hand, when they have been put before their nouns, the motive for doing so, which was at first merely euphony, has been changed in an increasing number of cases into a desire to call forth the fancy of the reader and make it dwell longer on the quality denoted by the epithet, or else to invest the epithet with a vigor or with a mysterious glow which it never possesses when standing in its usual place after the noun. This tendency, is scarcely at all perceptible in Bossuet and La Bruyère, begins to appear in Fénelon and Rousseau, is very marked in Chateaubriand whose preposition of *sacré* is a beautiful instance of it, and finally appears most perfect in Prosper Mérimée.

The persistent cultivation of style among the French has doubtless resulted in developing other peculiarities of syntax which a patient study of French writers will reveal.

On the so-called Dying Alexander of the Uffizi Gallery, by A. EMERSON.

[Abstract of a paper read at the meeting of the University Philological Association, March 2, 1883].

This paper was an attempt to prove the connection of the Florentine head with the Gigantomachia of Pergamum. By the help of a photograph, attitude and expression were analyzed and found to exhibit agony, though lesser in degree, similar in kind to that of the Laocoön. Archaeologists have been unable to come to any satisfactory decision on the subject represented. The writer referred the traditional name of Dying Alexander to a careless misapprehension of Plutarch. Alex. Magn. 4 and Plut. de Al. M. virtute aut fortuna II. 2. The bust presents some features of resemblance to other real and supposed portraits of Alexander, but the possibility of the production by a Greek sculptor of so fanciful a work as a portrait of this pattern was denied. The style of the work, however, justifies ascribing its invention to the last period of Greek Art before the Alexandrine. This would connect it with the schools of Rhodes and Pergamum. Before the late discovery of the great Pergamene frieze, attempts at naming the subject could not be more than guess work. The archaeologist of the German expedition, Conze, was struck by the resemblance to the Alexander of a giant's head of the altar-frieze. See Bericht über die Ergebnisse der Ausgrabungen zu Pergamon, p. 52 and Fig. D. on p. 53. The resemblance is evident, but the cut is too small to allow of a closer consideration, while there is reason to believe that the original of the Uffizi head is to be sought in the missing one of the fallen giant of Plate III. Without any alteration of antique portions, the Alexander head, as presented in a photograph taken from the point of view artistically most advantageous, can be drawn into the wood-cut on this plate. The eyes are then directed towards the aegis of Zeus, of which the effect is observable in the features of the face as well as in the preserved body. Especial stress was laid on the complete artistic parallelism, required by the pendant relation of the Zeus and Athena groups, between the head under consideration and that of the winged giant of Plate IV.

It is a curious confirmation of the theory advanced that Overbeck (Kunstarch. Vorles., p. 137, quoted by Wieseler in Müller's DAK.), seeing in the work the expression of "a sudden, surprising pain," suggested an altogether analogous subject: "Capaneus, at the moment when Zeus' thunderbolt strikes him in the neck and is about to hurl him from the scaling-ladder."

On the Second Mutation of Consonants in French Words of Germanic Origin, by H. C. G. v. JAGEMANN.

[Abstract of a paper read at the meeting of the University Philological Association, February 2, 1883].

The German tribes who settled in France during the 5th and 6th centuries introduced into the French language about 750 Germanic words. Very few of these words show in their present state the characteristics of the High German mutation of consonants, although the fact that the French have taken their name for Germany from Alemania seems to point to Upper Germany as the centre of emigration. The reasons of this apparent incongruity are:

A. On Germanic ground: (1) a large number of words came from Low German, principally Norse and Dutch sources, among others the whole vocabulary of the French seamen. (2) The second mutation of consonants was not accomplished when the majority of German words were introduced into French. This appears especially from the treatment in French of the Low German TH which is regularly rendered by T (thiudisk > O. Fr. tiois, Ital. tedesco, Span. tudesco; tharrjan > Fr. tarir, etc.); showing that TH had not only not yet become D but had not even reached the necessary intermediate stage of TH, as represented in Isidorus.

B. On French ground: (1) The French were unable to pronounce several of the High German consonants, especially the aspirates, and changed CH back into K, and PF, PH into P. (2) The Romance mutation of the medial consonants:

Lat. Ital. muTare > Span. Prov. Port. muDar > Fr. mu‸er
" " saPere > " " " saBer > " savoir
" " amiCa > " " " amiGa > " ami‸e

worked in the opposite direction from, and therefore counteracted the effects of, the Germanic mutation.

On a Transposition in Seneca, by J. R. HARRIS.

The method which I recently applied to the case of a transposed passage in the New Testament has an interesting illustration in Seneca, ad Marciam. Madvig (Adversaria Critica, p. 355) pointed out that two passages had been transposed in c. 17, and that the words "Dicit omnibus nobis natura . . . qui tibi nihil certi spoponderunt" (c. 17, 6, 7) should in reality stand after the words "sed humanum est" (c. 17, 1). Almost all such cases of transposition arise from the misplacement of a sheet or sheets in the MS. or papyrus roll of which they form a part. And it follows at once that in all such errors we must have an integral number of pages for each of the two passages concerned in the transposition, and also an integral number of pages for the portion of the book antecedent to the disputed ground. Let us apply these tests to the passages of Seneca just referred to.

Taking the Teubner edition as our standard, we have to carry a passage 12.6 Teubner lines in length to a place 38 lines earlier. Obviously 38 is 12.6 × 3 very nearly. Assuming 12.6 lines to represent a single page of manuscript, the space through which it has to be moved is three pages. The previous part of the book is 568 lines = 45.0 × 12.6 very nearly.

The error, therefore, arose at the 46th page of the MS., and consisted in placing the 46th page after the 49th. Madvig's criticism is therefore completely confirmed.

In the next place, we may enquire into the stichometric size of the page in question. The average Teubner line being found to be 46.9 letters, or somewhat less, and the average hexameter being about 36 letters, a page of 12.6 Teubner lines is about 16 hexameters.

Finally, the remainder of the book being reckoned, we have for the MS. in which the error was made a roll of very nearly 83 complete pages.

On the Nature and Extent of the Athenian Jurisdiction over their Allies, by C. D. MORRIS.

[Abstract of a paper read at a meeting of the University Philological Association, March 2, 1883].

The text of this paper was Thucyd. i. 77. 1, *καὶ ἐλασσούμενοι γὰρ ἐν ταῖς ξυμβολαίαις πρὸς τοὺς ξυμμάχους δίκαις καὶ παρ' ἡμῖν αὐτοῖς ἐν τοῖς ὁμοίοις νόμοις ποιήσαντες τὰς κρίσεις φιλοδικεῖν δοκοῦμεν*. It was shown that most of the translators and interpreters are in error, because they explain both clauses to this passage as having reference to the same subject matter. In order to make this possible Boeckh, Grote, and Prof. Goodwin declare that *ξυμβόλαιαι δίκαι* cannot mean *δίκαι ἀπὸ ξυμβόλων*, because the latter involve reciprocity of suing and being sued, whereas the concluding clause of the passage evidently refers to suits which were brought by compulsion in Athenian courts. On the other hand Curtius and Prof. Jowett believe that *ξυμβόλαιαι δίκαι* and *δίκαι ἀπὸ ξυμβόλων* are identical, but extend the meaning of the latter phrase so that it includes all this compulsory jurisdiction of the Attic courts, and thereby is divested of the implication of equitable reciprocity which is properly inherent in it. Much light has been thrown on the whole question by the recovery of various inscriptions which have been subjected to minute scrutiny by Köhler, Fränkel, and most recently by J. M. Stahl. The results reached by him were stated in detail and discussed; and the conclusion was arrived at (1) that suits arising out of commercial dealings (*ex contractu*) between the Athenians and their allies were decided *ἀπὸ ξυμβόλων* on terms of equitable reciprocity, more or less, in the courts of the defendant's city; (2) that suits arising *ex delictis* between Athenian citizens and citizens of allied states were decided in Athenian courts; (3) that suits arising *ex delictis* between citizens of an allied state were tried at first in the local courts, with the provision, however, that, if the sentence were death, exile, or disfranchisement, the condemned person should have the right of appeal to Athens; (4) that at a later time it is probable that the more important of such cases were brought to Athens in the first instance; (5) that ordinary civil cases arising between citizens of an allied city were always decided at home. It was further pointed out that the expressions quoted by the grammarians (as that in Hesychius, *ἐδίκαζον 'Αθηναῖοι ἀπὸ συμβόλων τοῖς ὑπηκόοις καὶ τοῦτο ἦν χαλεπόν*) seem to conflict with the first of the above points, and to deny the reciprocity which was no doubt an essential element in commercial treaties; for if such treaties were observed with perfect equity, it ought to be equally true to say *ἐδίκαζον οἱ ὑπήκοοι τοῖς 'Αθηναίοις*. But these expressions in all probability state only what was the practical result as it was realized by the Greeks; for (1) in most cases Athenians would be the aggressors, and therefore the defendants; and then by the terms of the *ξύμβολα* the suits would be tried at Athens; and (2) since all suits in which Athenians were defendants would be tried at Athens, and those in which they were plaintiffs would be tried in different cities, the judicial range of the Athenian courts must have greatly surpassed that of the courts of any one of the allied cities, perhaps of all of them together. Thus even without any formal infraction of the reciprocity implied by the existence of *ξύμβολα*, the impression may easily have come to exist, which the statements referred to seem to express, that it was the Athenians who decided in accordance with the terms of the several *ξύμβολα* the commercial suits of their subjects.

On ΕΠΙΣΤΗΤΑΙ, (Π 243).

Query:

The form *ἐπίστηται* occurs Π 243, in a disjunctive dependent interrogative sentence, where an indicative is necessary. La Roche says nothing about the form; others try to explain it as a subjunctive but that it certainly cannot be. Others admit that it is an indicative but cannot explain the form. G. Meyer in his Gr. Gr. p. 372, says that the strong form *στη* has penetrated into the present middle but cites no parallel examples. Is there no other explanation possible? E. H. S.

Answer:

The form may be a perfect, *ἐπίστηται* =**ἠπίστηται*, the sense of composition having been lost as is shown by *ἠπιστάμην*, *ἠπιστήθην*. Or if the sense of composition is not lost, *ἀπότμηται*, *διακόρισται*, *ἐπίτευκται* Hesych. might be cited. See Curtius, Gr. Verb. II, 144. But these belong to a different sphere of the language. The perfect is used like *οἶδα*, *ἔγνωκα* and that group. B. L. G.

[Scientific Notes Continued].

NOTES IN MATHEMATICS.

On a New Theorem in Partitions, by J. J. SYLVESTER.

[Being the substance of a lecture given at the Johns Hopkins University in the month of March last].

It is a well-known theorem that the number of partitions of n into odd numbers is equal to the number of its partitions into unequal numbers. This equality was seen by Euler to result from the identity

$$(1+x)(1+x^2)(1+x^3)\ldots=\frac{1}{(1-x)(1-x^3)(1-x^5)\ldots}.$$

It may also be proved easily by the method of correspondence. For if we call the partitions of n into odd numbers (repeated or not) the U, and into unequal numbers the V system, any V will be of the form $[V_1, V_2, V_3, \ldots,]$ where V_i is of the form

$$q_i.2^{a_i},\ q_i.2^{a'_i},\ q_i.2^{a''_i},\ldots,$$

each q being an odd number and all the q's unlike.

Hence writing

$$2^{a_i}+2^{a'_i}+2^{a''_i}\ldots=A_i,$$

V is transformable into $A_1q_1, A_2q_2, A_3q_3, \ldots$, which is a member of the U system.

And conversely any U as $A_1q_1, A_2q_2, A_3q_3, \ldots$, will be transformable into a V by decomposing each V into a sum of products of its largest odd divisor into distinct powers of 2 which can be effected in one and only one manner; so that there is a one-to-one correspondence between the U's and V's, and the number of the one set is therefore the same as the number of the other. The theorem which is now to be explained is, so to say, a differentiation (in the Herbert Spencer sense) of this theorem.

It regards the U and V system each broken up into classes and affirms the equality between the numbers of U's in any class and of the V's in the homonymous class. The proof of this by an analytic identity remains to be discovered—it is effected without great difficulty by the method of correspondence: but what is very worthy of notice is that the V which corresponds to a U, in the more refined construction about to be explained is in general (and it may be universally) different from the V which corresponds to it, when the preceding method of conjugation is adopted.

Every U which contains i distinct parts is said to be a U of the ith class, and every V which contains i distinct sequences (not running together) of consecutive numbers is said to be a V of the ith class—and my theorem may be expressed by saying that there exists a one-to-one correspondence (and therefore equality of content) between the U's of any class and the V's of the same class. I ought perhaps rather to say that a correspondence can be *instituted* than that a correspondence *exists*, for the fact that two absolutely unlike bonds of correspondence connect the totality of the U and that of the V system seems to indicate that such correspondence should rather be regarded as something put into the two systems by the human intelligence than an absolute property inherent in the relation between the two. Kant makes a similar remark upon the elementary conceptions, (such as the circle) which form the groundwork of geometry.

As an example of the numerical part of the theorem consider the 3d class of the U's and V's for $n=16$.

The U's of this class will be

$$11.3.1^2;\ 9.5.1^2;\ 9.3^2.1;\ 9.3.1^4;\ 7.5.1^4;\ 7.3^2.1^3;$$
$$7.3.1^6;\ 5^2.3.1^3;\ 5.3^3.1^2;\ 5\ 3^2.1^5;\ 5.3.1^8;$$

and the V's which are somewhat more difficult to calculate by an exhaustive process will be found to be

$$1.6.9;\ 1.2.5.8;\ 2.6.8;\ 1.5.10;\ 1.2.4.9;\ 2.5.9;$$
$$1.4.11;\ 1.3.4.8;\ 3.5.8;\ 2.4.10;\ 1.3.12.$$

So again of the 4th class there is only one U and one V, viz., 1.3.5.7, which is common to the two systems—and of the first class owing to 16 containing only one odd division, viz., unity, there is also but one U and one V, viz., the undivided 16 for each alike. In general for the first class the number of U's is obviously the number of odd divisors of the partible number n and the number of single sequences is easily seen to be the same. Thus, *ex. gr.*, for 15 there exist the sequences 1.2.3.4.5; 4.5.6; 7.8; 15; and for 9 the sequences 2.3.4; 4.5; 9.

I will now indicate the mode of proof, the particulars of which will be found set out in full in the forthcoming number of the *American Journal of Mathematics.*

The partible number n being given, I take any U belonging to it and form two graphs, one whose rows represent the major halves of each part of U and the other its minor halves [$q+1$ is the major and q the minor half of $2q+1$]. I then dissect each of these graphs into its component angles and take the content of each; it is easily seen that beginning with the major and passing from it to the minor and back again to the major and so on continually in alternate succession, the readings will form a continually decreasing series of numbers whose sum will be the same as of the parts of the U, and thus U will be transformed into V. The number of parts in V, if we agree to consider that number as always *even* by supplying a zero at the end if it should happen to be *actually* odd, will be $2i$ where i is the number of points in the side of the Durfee-square appertaining to the major graph.

Conversely, if any V be given containing or made to contain $2i$ parts, it is easy to construct a system of $2i$ *linear* equations between the contents of the first i lines and the first i columns of an assumed U having a Durfee-square containing i^2 points which shall transform into the given V, and to prove that these contents will be all of them greater than $2i$: hence *one* and *only one* U corresponds to a V, and consequently there is a one-to-one correspondence between the entire U and entire V systems. It remains to show that any U_i (a U of the ith class) by the prescribed process of transformation becomes a V_i (a V of the ith class).

This is effected as follows: suppose the first exterior angle to be removed simultaneously from a given major graph and its accompanying minor: begin with supposing that U_i becomes V_j: i is the number of unequal lines in either graph and it is easily proved that $i-j$ remains unaltered by the contraction of the graphs in the manner above indicated: *i. e.*, it can be shown that the effect of the contractions is to diminish i and j simultaneously each of them by 0, each of them by 1, or each of them by 2.

Continuing this process of *stripping* the graphs of their outside angles we must come at last to a graph consisting of one line and one column or of only one line, or only one column, or only a point. In the first of these 4 cases i and j are each equal to 2, and in the last 3 each equal to 1, hence $i-j$ is always zero and every U_i corresponds to a V_i. This establishes the very remarkable theorem that was to be proved.

Note on the Graphical Method in Partitions, by J. J. SYLVESTER.

It is well I think to draw attention to the fact that the graphical method introduces two new processes into Arithmetic as elementary and fundamental as those contained in the well known 4 rules—which may be called Transversion and Apocopation.

Transversion is the operation of passing from a partition to its conjugate or transverse, and is identical with that which borrowing from the vernacular of the American Stock Exchange I have elsewhere denominated "*calling.*"

The elements of a partition may be regarded as *Sellers* each holding a certain number of shares in the same stock. On the numbers 1, 2, 3 . . . being successively called out each seller who holds at least that number of shares declares himself, and the number of those so responding each time being set down, a new partition is formed with numbers whose sum is identical with the total number of shares on sale.

The discovery of this process is due to Dr. Ferrers, who informs me that he himself never published it but left it to me to do so in his name in the *London and Edinburgh Philosophical Magazine* for 1853. I may mention that I have never missed an opportunity of expressing my sense of the great importance of the discovery and bringing it under the notice of my pupils, to one of whom, Mr. Durfee (Fellow of this University), is due the discovery (after the lapse of 30 years) which leads to the second the 2 radii to a point of S from the foci of any one pair make equal angles, on opposite sides, with the tangent at the point; the 2 intersections of a tangent of S with the absolute chords of any one pair are equally distant, on opposite sides, from the contact of the tangent.

A circle is a conic S having double contact with the absolute; it has one isolated centre C, and a line of centres (the common polar of C *quâ* Ω and S); the distance of any point of S from C is constant; not so with the distance of any point of S from a centre of the line; the 2 tangents to S from any point in the plane are of equal lengths; the circle has one isolated axis (the line of centres) and a pencil of axes through the isolated centre; the distance of any tangent of S from the isolated axis is constant; not so with the distance of any tangent from an axis of the pencil; the tangents to S at its 2 intersections with any line in the plane make equal angles with the line; any tangent to S is perpendicular to the radius to its point of contact from the isolated centre; any point of S is perpendicular to the intersection of the tangent at that point with the isolated axis.

Two circles are relatively *orthogonal* if their tangents at an intersection are mutually perpendicular, say they have an orthogonal intersection; 2 circles are relatively *orthometric* if their contacts with a common tangent are mutually perpendicular; say they have an orthometric common tangent; then two relatively orthogonal circles have 2 and only 2 orthogonal intersections, and 2 orthometric circles have 2 and only 2 orthometric common tangents.

Two circles have 2 *radical axes*, those common chords which intersect in the intersection of their isolated axes; the 4 tangents to 2 circles from any point of either of their radical axes are of equal lengths; the 6 radical axes of 3 circles meet by 3's in 4 points, the *orthogonal centres* of the 3 circles; these are the isolated centres of the 4 *orthogonal circles* of the 3 given circles; similarly 2 circles have 2 *radical centres*, those intersections of common tangents which lie on the junction of their isolated centres; the angles which any line through either radical centre makes with the tangents to the circles at its 4 intersections with them are equal; the 6 radical centres of 3 circles lie by 3's on 4 straight lines, the *orthometric axes* of the 3 given circles; these are the isolated axes of the 4 *orthometric circles* of the 3 given circles.

On Partitions, *by* F. Franklin.

[Abstract of a paper read at the meeting of the University Mathematical Society, February 21, 1883].

Denoting by $(w:i,j)$ the number of ways in which w can be composed of i or fewer parts none greater than j, $(w:i,j)$ is the coefficient of a^jx^w in the development of

$$\frac{1}{(1-a)(1-ax)(1-ax^2)\dots(1-ax^i)},$$

so that the generating function in which the coefficient of x^w is $(w:i,j)$ is the coefficient of a^j in the development of the above fraction in ascending powers of a. To obtain this generating function directly, we observe that the number of ways of forming w with i or fewer parts of which one at least is a number greater than j, say $j+k$, is equal to the number of ways of forming $w-(j+k)$ with $i-1$ or fewer parts; that the number of partitions in which two at least of the parts are numbers greater than j, say $j+k, j+k'$, is equal to the number of partitions of $w-(j+k)-(j'+k')$ into $i-2$ parts, and so on; hence the G. F. required is

$$\frac{1}{(1-x)(1-x^2)\dots(1-x^i)}-\frac{x^{j+1}+x^{j+2}+\dots}{(1-x)(1-x^2)\dots(1-x^{i-1})}$$
$$+\frac{x^{j+1}(x^{j+2}+x^{j+3}+\dots)+x^{j+2}(x^{j+3}+\dots)+\dots}{(1-x)(1-x^2)\dots(1-x^{i-2})}$$
$$-\frac{x^{j+1}x^{j+2}(x^{j+3}+\dots)+x^{j+2}x^{j+3}(x^{j+4}+\dots)+\dots}{(1-x)(1-x^2)\dots(1-x^{i-3})}+\dots$$
$$=\frac{1}{(1-x)(1-x^2)\dots(1-x^i)}\left\{1-x^{j+1}\frac{1-x^i}{1-x}\right.$$
$$\left.+x^{j+1}x^{j+2}\frac{(1-x^{i-1})(1-x^i)}{(1-x)(1-x^2)}-\dots+x^{j+1}x^{j+2}\dots x^{j+1}\right\}.$$

The expression last written is a finite form of the generating function; but returning to the first expression, we may write it in the form

$$\frac{1}{(1-x)(1-x^2)\dots(1-x^i)}\left\{1-(1-x^i)\Sigma_1(x^{j+1},x^{j+2},\dots)\right.$$
$$\left.+(1-x^{i-1})(1-x^i)\Sigma_2(x^{j+1},x^{j+2},\dots)-\dots\right\},$$

where $\Sigma_m(x^{j+1},x^{j+2},\dots)$ means the sum of the m-ary combinations of the quantities $x^{j+1}, x^{j+2}, x^{j+3}\dots$ *ad inf.*; and it is easy to prove by induction that

$$(1-x^i)(1-x^{i-1})\dots(1-x^{i-m+1})\Sigma_m(x^{j+1},x^{j+2},x^{j+3}\dots)$$
$$=\Sigma_m(x^{j+1},x^{j+2},\dots x^{j+i}).$$

Hence the above generating function is equal to

$$\frac{(1-x^{j+1})(1-x^{j+2})\dots(1-x^{j+i})}{(1-x)(1-x^2)\dots(1-x^i)}.$$

But the method by which the equation last written is inductively proved suggests a more direct mode of obtaining the generating function by means of the correspondence in the partitions themselves; this method will be found incorporated in Prof. Sylvester's memoir on Partitions in the forthcoming number of the *American Journal of Mathematics*.

[*Addendum*. The theorem, due to Euler, that a number can be formed in as many ways with odd numbers, repetitions being allowed, as with general numbers unrepeated may be proved constructively and extended as follows: the number of ways of forming w with an indefinite number of parts not divisible by k and with m distinct parts (each indefinitely repeated) divisible by k is equal to the number of ways of forming w with an indefinite number of parts each occurring less than k times and with m distinct parts each occurring k or more times. To prove the generalized theorem when m is zero, we may suppose, to fix the ideas, that $k=10$, the reasoning being perfectly general. Consider any partition consisting only of parts not divisible by 10, let the number of times any such part λ occurs be written in the decimal notation . . . cba; then if in place of . . . cba times λ we write a times λ, b times 10λ, c times 100λ, . . . we get a partition in which no part occurs as many as ten times; and we have evidently a 1 to 1 correspondence. Thus the theorem is proved when $m=0$. If now along with the non-tenfold parts we introduce m distinct parts each of which is divisible by 10, and at the same time introduce in the corresponding partition of the other set ten times these same parts each divided by 10, the partitions of the second set will contain m parts occurring 10 or more times, while the 1 to 1 correspondence will not be disturbed. This proves the theorem].

On the Tabulation of Symmetric Functions, *by* W. P. Durfee.

[Abstract of a paper read at the meeting of the University Mathematical Society, February 21, 1883].

At a former meeting of the Society, I gave an outline of a method of arranging the partitions of a given number so that the table of symmetric functions of that weight should be symmetrical and at the same time be confined to a half square with the exception of certain coefficients which belonged to the lines and the columns of the self-conjugates. While the method there given was somewhat imperfect I find that there is a definite arrangement which effects the desired end. It may be stated as follows: Write the partitions in groups beginning with the group containing those of one part, then that containing those of two parts and so on, arranging the partitions of each group in natural or dictionary order, and omitting all partitions whose conjugates have been written earlier and all self-conjugates. This will include one-half of all the partitions less the self-conjugates. Write next the self-conjugates in any order and finally write the conjugates of the first part in inverse order. If the partitions at the head and side of the table be written in this order the table will have the desired form.

A paper containing the principles upon which the foregoing is founded, will appear in a future number of the *American Journal of Mathematics*.

to secondary changes which have acted upon the ova and the embryos. For this reason no direct evidence has been hitherto obtained. At Beaufort during the last summer some work was done upon Thalassema, a species of worm which possesses a very primitive development and enables a direct study of the origin of bilateral symmetry from radial symmetry to be made. The results of the observations were satisfactory upon the point in question, and showed that as far as this group of animals is concerned, the second of the above views, viz.: that of Balfour, is in all essential respects correct. The radially symmetrical gastrula elongates nearly at right angles to its long axis, and gives rise to a bilateral larva, of which the ventral surface has been from the first indicated by the position of the mouth. The acquisition of a direct motion occurs sometime after the animal is truly bilateral, an indirect revolutionary motion being gradually changed into a direct motion with its anterior extremity in advance.

List of a few Additions to the Species of Birds, Reptiles and Batrachians Mentioned in Dr. Elliott Coues' Paper on the "Natural History of Fort Macon and Vicinity," by H. GARMAN.

[The species mentioned below were observed at Beaufort in 1881 while studying at the Johns Hopkins Marine Laboratory].

Sialia sialis.—September.
Sophophaues bicolor.—September.
Parus carolinensis.—September
Sitta pusilla.—September.
Muiotilta varia.—September.

Deudrœca æstiva.—This bird was noticed at Beaufort in September feeding on the fruit of a "mulberry tree." This is the second instance which has come under my observation of a warbler attacking fruit. *Helminthophaga peregrina* seriously injures the grapes in North Illinois by puncturing them and sipping the juice.

Dendrœca pinus.—September.
Siurus nævius. August 14.
Setophaga ruticilla.—September.
Trochilus colubris.—July. (Abundant).
Picus pubescens.—September.
Cistudo clausa.—Probably the Cistudo refered to by Dr. Coues.
Nanemys guttatus.
Cinosternum pennsylvanicum.—(Abundant).
Chelydra serpentina.
Enmeces fasciatus.

Anolis principalis.—Beaufort is probably near the northern limit for this species. Holbrook says it does not occur north of the 34th parallel of latitude. It was abundant about rail fences which were partially overgrown by herbage. Under the influence of fright, or at will, the color may change from a bright green to dull olive brown or the reverse. When the green color predominates a slight pinch with a pair of blunt forceps causes a brown spot to appear at the point compressed. During the summer of 1882, they were seen in the interior of North Carolina running about on the leaves of trees and springing from branch to branch in pursuit of insects.

Bufo quercicus.—A single pale specimen of this peculiar toad was collected at Beaufort. From an examination of the stomachs of several specimens of this species taken at different dates and localities in North Carolina, I find that it feeds exclusively on ants. The note resembles that of a young plover. Specimens do not vary much from an inch in length from the snout to the tip of the urostyle. Apparently breeding near Wilmington, July 20, 1882.

Note on the Anatomy of the Malar Bone, by E. M. HARTWELL.

[Abstract of a paper read at the meeting of the University Scientific Association, March 7, 1883].

Attention was called to the proposal of Dr. F. W. Langdon, of Cincinnati, in a paper on the Madisonville Prehistoric Cemetery, (published in the Journal of the Cincinnati Society of Natural History, October, 1881,) to apply the name of "temporal process" to "a spine-like and occasionally unciform process," found to occur on the posterior upper border of the malar bone in a large number of the human crania exhumed at Madisonville, Ohio. It was shown that the term "*Processus temporalis*" was applied to the posterior lower process of the malar bone as early as 1794, by Loder; that, while in the standard English manuals of anatomy, with the exception of the ninth edition of Quain, this lower process is termed zygomatic, the best German anatomists have long followed the nomenclature of Loder. It was further shown that the process proposed to be called "temporal" by Dr. Langdon, was named *Processus marginalis* by Prof. H. Von Lushcka, of Tübingen, in 1867, which name has been adopted by Henle; that Broca termed it "*Epine jugale*" or jugal spine; that G. J. Schultz, of St. Petersburg, called attention to the same process in 1852, without giving it a special name; and that Vesalius in the first edition of his "*De Humani Corporis Fabrica*," published in 1543, distinctly figured and specially marked the marginal process of Luschka. It was suggested that the marginal process of the malar bone possessed less anthropological significance than had been supposed, inasmuch as the writer had determined its occurrence in skulls of all the principal races of men represented in the Morton Collection of Crania, in Philadelphia.

[Scientific Notes Continued].

NOTES IN CHEMISTRY AND PHYSICS.

On the Action of Phosphorus on Moist Air and Carbon Monoxide, by IRA REMSEN.

[Abstract of a paper read at the meeting of the University Scientific Association, February 7, 1883].

The speaker gave an account of experiments which he has been engaged upon for some time past with the assistance of Mr. E. H. Keiser. The object was to determine whether phosphorus and moist air have the power to oxidize carbon monoxide. Leeds and Baumann agree that the carbon monoxide is oxidized. In the light of some results recently obtained in this laboratory the conclusion of the above named chemists seemed improbable and hence their experiments were repeated. After a large amount of labor had been spent in the investigation, an apparatus was finally devised in which all joints were protected with either water or mercury, so that the ozone formed by the action of the phosphorus in the air could not come in contact with organic substances like cork or rubber in its passage through the apparatus. It was only when this precaution was taken that the gases drawn through the apparatus failed to produce a precipitate of barium carbonate in baryta water. The effect was exactly the same whether carbon monoxide was mixed with the air or not. The experiment was repeated a number of times, and always with the same result. There can hence be no doubt that the conclusion of Leeds and of Baumann is incorrect. Carbon monoxide is not oxidized by air in the presence of moist phosphorus.

Leed's error is easily accounted for. He passed the ozonized air from the flask containing the phosphorus through a tube containing cotton for the purpose of removing oxides of phosphorus. Now, ozone acts upon the oily substances which adhere to cotton and oxidizes them, forming carbon dioxide, and it was this that was collected and supposed to be formed by the oxidation of carbon monoxide. Special experiments were performed to prove the correctness of this supposition.

From the above it is clear that the experiment of Leeds and Baumann furnishes no evidence in favor of the view that there is an active form of oxygen distinct from ozone.

On the Helmholtz-Koenig Controversy, by G. BISSING.

[Abstract of a paper read at the meeting of the University Scientific Association, February 7, 1883].

In view of certain objections to Koenig's method [*Journal de Physique, December*, 1882], an attempt was made to determine by direct experiment the influence of the phase of the overtones on the timbre of a sound. Tuning-forks supplied with electro-magnets and resonators were used, and the difference of phase was obtained either by altering the lengths of the tubes which conducted the sound from the resonators to the ear or by putting the driving-forks slightly out of tune. But in neither case could the slightest influence of the phase on the timbre be detected.

Villes and Plantations, by H. B. ADAMS.

[Notes on a lecture delivered before the Peabody Institute January 30, 1883, and abridged for the Historical and Political Science Association, April 6, 1883].

Villes.—In the names of places throughout the older states, particularly at the South, the suffix *ville* is of such frequent occurrence as to be noticeable in gazetteers and upon county maps; but in popular speech, in designating small neighborhoods or hamlets, this suffix, used in connection with the name of some prominent family or with some dominant local interest, is even more common than in its printed forms. New England towns and Southern counties are full of small localities, too small for official recognition as post offices or as incorporated villages, and yet large enough to have local habitations and a name.

Attention is called to the fact that these numerous *villes*, in their hamlet-form, represent historically the minutest germs of state-life. They are not only the institutional seed from which spring larger communities, but they are the survival in name and fact of one of the oldest types of local life known to English history. The *ville* is not a corruption of the Romance *villa*, but a pure survival of the Germanic *Weiler*, or hamlet, which in Normandy was everywhere established by Teutonic influences, just as it was everywhere planted throughout the Rhine country in the *Heims* and *Weilers*, known to student-pedestrians. In England, as in Germany and Normandy, the *ville* has the historical character of a patriarchal hamlet or of a neighborhood of families. In the early statutes of England and in the older writers on English institutions, the word is often spelled "vill." Blackstone says, "Tithings, towns, or vills are of the same signification in law." The vill became an organic part of the state, a recognized civic unit, just so soon as it had a Constable or a Tithingman, who converted the place into a Ward and kept the local peace by legal authority.

Plantations.—It is an interesting fact that the first settlements in this country, both in the North and at the South, were everywhere called Plantations with precisely the same original significance in both sections of country. The word was a common one in English colonial usage and was applied to land occupied for cultivation, without regard to the kind of crop, whether English grain, Indian corn, tobacco, sugar, or rice. Plantations were of two sorts, individual and collective; the first sort was a mere farm; the second, a group of farms, often thus designated, as for example, "Cambridge Farms." In New England, the collective use of the old word survives in "Providence Plantations" and in the well-known Plantations of Maine. The settlements at the South were often collective or communal like Henrico Plantation and the New Bermudas, both of which were palisaded and consisted of a group of houses and farms. The original collective character of the Virginia Plantations is indicated in a somewhat striking way by the Act of 1624 (see Hening, i, 128) whereby "the inhabitants of every corporation shall fall upon their adjoyning salvages." In the South as well as at the North there were, from the outset, numerous private Plantations and, in the South, this type ultimately prevailed by reason of various economic and social causes, for example, the extent of land, the fertility of the soil, the nature of the crops, the influence of climate, the introduction of indented servants and slaves, together with the triumph of aristocratic ideas or of a country gentry, representing the rural order of civilization.

It is noteworthy that upon every private plantation there survived a kind of village-life in the so-called "Quarters," where, under the absolute authority of the master, a negro community was made to reproduce somewhat the same condition of things as existed in a community of serfs upon the manor of a feudal lord. The Negro "Quarters" consisted of rows of cabins or cottages, built along the line of a common street and separated from one another by fences and garden-"patches," within which limits the slaves were allowed to raise produce, pigs, and poultry of their own, precisely as did the mediaeval serfs. Moreover the slaves regarded some portions at least of their master's Plantation as did serfs their lord's waste land, namely as common for fuel and pasture. The swine of the negro-village were allowed to run at large in the master's woods, each one of the common herd bearing his negro-owner's mark, according to the custom of simple agricultural communities. Frederick Law Olmsted, whose writings are among the best sources of Southern economic history, says, "It is told me as a singular fact that everywhere on the plantations, the agrarian notion has become a fixed point of the negro system of ethics: the result of labor belongs of right to the laborer, and on this ground, even the religious feel justified in using massa's property for their own temporal benefits."

One of the most remarkable descriptions by Mr. Olmsted is of a rice Plantation in Georgia, where an enterprising slave-owner of Northern birth reproduced among his negroes the thrifty village-life and the neat tenement-houses of New England. He even instituted a village-green or town common, two hundred feet wide. It was no uncommon thing upon Southern Plantations for the more practical arts and trades to be successfully carried on by negro slaves, who made excellent carpenters, blacksmiths, and mechanics, and who dealt in small wares in a thriving way. Not only was the economy of an English village reproduced under the direction of white men upon the Southern Plantations, but even the parish-life of white masters was roughly copied by their slaves who had churches and chapels, parsons, and congregations, that united families in a larger local life than could a single negro-village.

The local government of Plantations was personal and more or less paternal. In some states the law required the owner of ten slaves to employ an overseer. This office probably had its origin in the old English household custom of supervising the work of servants and apprentices, who were held to a strict account of themselves by family-overseers and local tithingmen (the latter overseeing a neighborhood-group of at least ten families). We see the outcroppings of these old English customs in the instructions of the Massachusetts Company in 1629, "to the Governor and Council for London's Plantation," at Salem. They were to "appoint a carefull and dilligent overseer to each familie, who is to see each person employed in the business... appointed for... The said overseers... are to keepe a perfect register of the dayly worke done by each person in each familie" (Records of Mass. i, 400-1). In the Plymouth Plantations there were appointed white "overseers," of the Indians, who lived in scattered villages and were held strictly to right in groups of ten under the direction of Indian Tithingmen and Indian Constables, who apprehended every "runaway" Indian servant and brought him before the nearest Overseer "to be whipt and sent home to his or her master." Negro "Drivers" performed similar offices for the Overseers of Southern Plantations, where the Old English constabulary system survived in the so-called "Patrol." The system of written "passes" for negroes going to and fro between Plantations at the South was in vogue in Plymouth Colony, where no Indian was permitted to go from one Plantation to another without a "pass" from his "Overseer," stating where he was going, for what reason, and how long he could stay. If found without a pass, a strolling Indian could be arrested, fined, "or be whipt and sent home to his owne place." This custom of Plantation "passes" had its origin in the parish laws of old England against vagabonds and was introduced into the parish life of the South.

The Township in Maryland, by L. W. WILHELM.

[Abstract of a paper read before the Historical and Political Science Association, January 29, 1883].

One of the most important and interesting territorial divisions of the early English tribes was the township. According to Canon Stubbs it may have represented the allotment originally granted settlers, or the settlement of kindred, or the estate of a great proprietor. The inhabitants of the township were allowed to make local laws for their own government and to be represented in the more important assemblies of the hundred court and shire court. The erection of manors disturbed the autonomy of the township, so that the latter were not allowed to legislate upon matters of manorial jurisdiction.

The prevalence of manors in colonial Maryland prevented the development of the township system. The history of the territorial divisions of Maryland is as yet unwritten. It is, however, very probable that the township never existed as a distinct organization. The so-called Nottingham Township mentioned in some statutes in Kilty's Laws of Maryland is well described in Johnson's History of Cecil County. Nottingham lay in the extreme northern part of the county, containing about 18,000 acres. It had formerly been a part of Chester County, Pennsylvania, but was ceded to Maryland about the year 1732.

Some villages of Maryland were made the popular center of the surrounding country in a manner somewhat analogous to the villages of the

New England towns. By an Act of 1812, ch. 72, the village of Snow Hill, Worcester County, was constituted. The ten commissioners chosen were to live within the village or within a radius of three miles. They were authorized to call town-meetings of voters upon "extraordinary occasions."

The occurrence of the word "townland" in the earlier statutes of Maryland indicates the possible influence of Irish polity upon the colonial legislation. As Calvert's manor of Baltimore, in Longford County, was situated almost in the heart of Ireland, he must have recognized and profited by Irish territorial subdivisions. These were the barony or hundred, the parish, the townland, and the manor. An Irish historian alludes to the "townlands" as "the ancient and recognized divisions of the country." They were the smallest territorial subdivisions. It is somewhat curious that although "the natives of Ireland never performed so good a work as to build a city," yet from time immemorial they possessed townlands. Many of the towns of Maryland laid out by Act of 1683 were ordered to be erected upon existing townlands.

The Baltimore and Ohio Employés Relief Association, by B. J. RAMAGE.

[Abstract of a paper read before the Historical and Political Science Association, February 23, 1883].

This association was inaugurated May 1, 1880, and incorporated two years later by the State of Maryland. It is based upon the mutual assessment and insurance plan. For some time previous to its inception, the managers of the Baltimore and Ohio Railroad had been discussing the subject, but no definite action was taken until the railway systems of England and the continent had been carefully studied. The company subscribed $100,000 as the nucleus of a relief fund and issued a circular to its employés which explained the object and rules of the association.

The association is governed by Constitution and By-Laws, and its operations embrace three features: (1) an Accident feature; (2) an Annuity feature; (3) a Savings and Building feature.

In order to secure equitable rates the employés are divided into two classes: (1) Those engaged in operating trains and rolling stock; (2) Those not so engaged. The employés of both classes contribute a certain percentage of their wages, monthly and in advance, and are entitled to benefits in proportion to their contributions. The annexed table gives an idea of the method of assessment, as explained more at length by Dr. Wm. T. Barnard, of Baltimore, Secretary of the Association, in his second annual report, just issued (April, 1883).

The Association has as yet no hospitals of its own but special contracts are made with the leading hospitals along its line. The Savings Fund and Building Features have recently been added to the original plan for the following purposes: (1) To receive deposits, on interest, from those employés of the B. & O. R. R. Co., who are subscribers to its relief features, and from their wives; (2) To lend money, on approved security, to said employés at lawful rates of interest, in order to provide them with homesteads or to improve the same; (3) To acquire every description of freehold or leasehold property adapted for building purposes, and to sell or lease the same to the employés, in large or small quantities.

When the association first began its operations, membership was optional with the employés, but, success being assured, all were obliged to subscribe. In order to secure any of the benefits promised by the association, a contributor must relinquish all claims for damages against the Company, arising from disability or from death by accident. The advantages of the association may be extended to the employés of other roads, if the association deems it expedient. The managers are now discussing the propriety of establishing a circulating library for the benefit of the employés.

From May 1, 1880, the date of the organization, to December 31, of the same year, the receipts in gross were:

Dues from members..	$85,543.26
Six months' interest on the Company's donation of $100,000 at 6 per cent..................................	3,000 00
	$88,543.26

Amount carried forward,		$88,543.26
The disbursements were as follows:		
Allowance to members.................................. ..	$38,866.19	
Physicians' fees..	2,636.95	41,503.14
Balance.......................		$47,040.12

The aggregate receipts for the twenty-one months intervening between January 1, 1881, and September 30, 1882, were $345,088.30, and the disbursements for the same period amounted to $302,617.69.

SALARIES.	PAYMENTS PER MONTH.	BENEFITS.				
		1.	2.	3.	4.	5.
		In case of temporary disablement by accident, while in the discharge of duty the monthly payment, for a period not exceeding six months, of Per day	In case of permanent disablement and incapacity to resume employment arising from accident while in the discharge of duty, the monthly payment (after the 6th month) during continuance of such disablement, of Per day.*	In case of death arising from accident while in the discharge of duty, the payment to the legal representative, within sixty days after death of	In case of injury or sickness from any cause other than accident while in the discharge of duty causing total inability to labor, the payments (not longer than 1 year) of a daily allowance of	In case of death arising from any cause other than accident while in the discharge of duty, the payment to the legal representative, within sixty days after death of†
1. Those receiving $35 and under per month should pay..........	1st class $1.00 2d " 75c.	$ .50	$ .25	$500	$ .50	$100
2. Those receiving $35 and not more than $50, should pay....	1st " $2.00 2d " 1.50	1.00	.50	1,000	1.00	200
3. Those receiving $50 and not more than $75, should pay....	1st " $3.00 2d " 2.75	1.50	.75	1,500	1.50	300
4. Those receiving $75 and not more than $100, should pay...	1st " $4.00 2d " 3.00	2.00	1.00	2,000	2.00	400
5. Those receiving $100 should pay......................................	1st " $5.00 2d " 3.75	2.50	1.25	2,500	2.50	500

* Including free surgical and hospital treatment.

† Subject to increase predicated upon surplus at end of each year, now double this stated allowance.

The Editor of the University Studies in Historical and Political Science announces that arrangements have been made for the publication, in this series, of the following papers, in addition to those heretofore announced by him:

The Genesis of a New England State (Connecticut). By ALEXANDER JOHNSTON, A. M. Rutgers, 1870.

The Past and Present of Political Economy. Read before the Historical and Political Science Association, October 20, 1882. By R. T. ELY, Ph. D. Heidelberg, 1879.

Review of American Economic Literature since 1876. This review will first appear in Conrad's *Jahrbücher der National-oekonomie*, Halle. By E. J. JAMES, Ph. D. Halle, 1877, and B. J. RAMAGE, A. B. Newberry College, S. C., 1880.

Taxation in the United States from 1789 to 1816. A revision of a thesis first published in the *Tübinger Zeitschrift*, 1879. By HENRY C. ADAMS, Ph. D. Johns Hopkins University, 1878; Lecturer on Political Economy in the University of Michigan and at Cornell University.

An Essay on the Financial History of the United States during the Civil War. Read before the Historical and Political Science Association, February 10, 1883. By ARTHUR YAGER, A. B. Georgetown College, Ky., 1879.

The Baltimore and Ohio Employés' Relief Association. Read before the Historical and Political Science Association, February 23, 1883. By B. J. RAMAGE.

The Study of Political Science in Continental Schools. By E. J. JAMES.

The Growth of Internationalism. Read before the Historical and Political Science Association, May 19, 1882. Published in the *International Review*, April, 1883. By ALBERT SHAW.

THE DEVELOPMENT OF RENILLA.

By E. B. WILSON.

[Abstract of a paper communicated, through Professor Huxley, to the Royal Society, London, at its meeting, December 14, 1882, and reprinted from its Proceedings, No. 222].

The following abstract contains the more important points established by a study of the development of *Renilla*, which was carried on at intervals during three years at the marine laboratory of the Johns Hopkins University, conducted by Dr. W. K. Brooks. The need of farther studies on the embryology of polyps in general must be apparent to every zoologist; and *Renilla*, as a highly specialised form, presents a number of special morphological problems, which can only be solved by a study of the embryological history of the organism. This genus appeared, therefore, to be a doubly desirable object for study.

The paper is divided into four parts. The first comprises an account of the segmentation of the egg and formation of the germ-layers; the second a description of the formation of the tissues and organs of the primary or axial polyp; the third part treats of the formation of the colony produced by budding from the axial polyp; and the fourth deals with a few theoretical questions suggested by the phenomena observed. The leading points of the paper are as follows: —

I.

(1.) As in other Alcyonaria, *Renilla* is diœcious, and fertilisation is effected in the water after discharge of the generative elements through the mouths of the feeding polyps. The ovarian or spermatic follicles are ruptured and cast aside at the time of spawning.

(2.) The action of the vitellus during segmentation is *extremely variable*, while the division of the nuclei appears to be nearly regular. The vitellus, after a preliminary division of the nuclei, may divide at the first cleavage into two, four, (?) eight, sixteen, or thirty-two spheres, which may be equal or noticeably unequal. In some cases cleavage begins at one pole a considerable time before any sign of activity is shown at the opposite pole, so that the segmentation appears precisely like that of a true meroblastic egg. In others, again, the segmentation is irregular and extremely unequal, so as to appear quite like that of an epibolic gastrula. All of these forms gave rise, however, to quite similar larvæ, which were proved by isolation in small aquaria to be normal and healthy.

In several cases of division into sixteen and thirty-two spheres, the vitellus was observed to undergo slight changes of form some time previous to actual division. These changes appear to be the expression of attempts at division on the part of the vitellus, which has not, however, energy enough to carry out a complete cleavage. In other cases the attempts are partially successful and the egg divides incompletely into spheres which do not become clear and well defined until the following cleavage. The series of forms appears to be produced by variations in the activity of the vitelline protoplasm or in the resistance (in the form probably of deutoplasm) which is opposed to it. The phenomena are of considerable interest, as showing how natural selection may find a field for action even in the earliest stages of an organism, and as a caution against drawing too hasty conclusions in regard to the character of segmentation from the study of a few individuals only. It is further remarkable to find the action of the vitellus and of the nuclei as independent of one another as these facts seem to indicate.

(3.) Cleavage is at first superficial, a considerable central mass remaining unsegmented. The furrows finally extend to the centre, and a small temporary segmentation cavity is formed.

(4.) The layers are separated by a process of delamination. The endodermic mass is at first solid and is not separated by a supporting lamella from the ectoderm.

(5.) The supporting lamella is derived mainly from the ectoderm by a very peculiar process of secretion at the inner ends of the cells.

(6.) The gastric cavity is formed by absorption of the central endoderm cells by those which are more peripherally placed. The former undergo a peculiar process of disintegration and form a granular *débris* which is absorbed by the peripheral cells by a process which appears to be identical with the amœboid absorption of yolk observed by Reichenbach in the embryo crayfish. At this period the gastric cavity is without any communication with the exterior.

II.

(7.) The œsophagus is formed as a solid invagination of ectoderm, in which a slit-like cavity, elongated in the dorso-ventral plane soon appears. The lower end of the œsophagus is then absorbed, placing the gastric cavity for the first time in communication with the exterior. Much variation exists in the process of absorption. Most commonly it begins at one side, so that the bottom of the œsophagus hangs down like a valve from the opposite side. It is then absorbed bodily.

(8). The radial septa and the horizontal or peduncular septum differ widely in structure and mode of origin. The former arise simultaneously at the anterior end and grow backwards. Each septum consists of *two* layers of endoderm cells, separated by a structureless lamella. The peduncular septum arises at the posterior end and grows forwards. It is composed of *three* layers of endoderm cells, the middle of which atrophies. This septum is probably to be regarded as formed by the fusion of the dorsal pair of radial septa. The septa have a very marked bilateral arrangement.

(9.) The mesenterial filaments are formed as endodermic thickenings of the edges of the septa. After the formation of the mouth they become continuous with the invaginated ectoderm of the œsophagus. The filaments are arranged in pairs of different lengths and structure. The dorsal pair appears *last* and develops most slowly.

(10.) The tentacles appear simultaneously and are at first destitute of pinnæ. They arise as hollow cæcal outgrowths from the anterior extremities of the radial chambers.

(11.) The calyx-teeth are formed in a similar manner but in a definite sequence. The ventro-lateral pair first appear and then the median dorsal tooth. The remaining two pairs appear nearly at the same time, but the medio-lateral pair usually precedes the dorso-lateral. Occasionally, however, the reverse is true.

(12.) The muscles are entirely endodermic, with the possible exception of those of the tentacles. They are developed from the bases of epithelial cells, as "epithelio-muscular" cells or myoblasts. The cell-body, in many cases at least, becomes reduced to a small granular mass enclosing the nucleus and closely applied to the side of the fibre, and the entire muscle-element lies below the epithelium.

The muscles are arranged in two sets, longitudinal and circular, the latter being outside the former. The circular muscles form a nearly uniform sheet, but the longitudinal fibres are at first arranged in definite tracts which exhibit a striking bilateral symmetry.

(13.) The spicules are developed in the interior of cells and are of two kinds, ectodermic and endodermic, which differ widely in form and size. Professor B. K. Emerson has kindly examined them for me with the polariscope, and finds them to consist of a crystalline core, probably of aragonite, surrounded by an amorphous layer and this by a second crystalline layer, the axes of which correspond with those of the core.

(14.) The ventral chamber becomes closed in front by membranous outgrowths from the septa and body-walls. The dorsal chamber is closed by the forward extension of the fore edge of the peduncular septum, which finally unites with the dorsal wall of the body just anterior to the exhalent zooid (*vide infra*).

III.

(15.) The development of the buds is essentially like that of the axial polyp, but no trace of the peduncular septum is formed and the mesenterial filaments appear in a different sequence, the dorsal pair appearing first and developing most rapidly.

(16.) The buds which are to form sexual polyps appear always in symmetrically placed pairs, and, in the earlier stages, in a definite sequence. They are arranged in two simple lateral rows, which extend both forwards and backwards by the appearance of new buds upon the axial polyp. The backward extension is, however, limited, whence results the sinus, into which the peduncle is inserted. Anteriorly the two rows of buds extend forwards and downwards until they meet at the ventral side of the axial polyp, which is thus included within the disk.

New buds are constantly formed in the angles between older buds, and each lateral bud is in time enclosed by the younger adjacent buds in the same manner as the axial polyp.

(17.) The ventral sides of the buds are at first directed downwards, and hence, when the polyps in later stages bend upwards so as to assume a vertical direction, the ventral side is turned outwards, away from the centre of the disk.

(18.) The zooids develop in the same manner as the polyps and are indistinguishable from the latter in their early stages. They are at first single but soon multiply to form clusters, in which the ventral chambers of the zooids are always turned away from the centre of the group. The law of budding is therefore the same for the zooids and polyps. In rare cases the secondary zooids become in turn centres of multiplication according to the same law.

The axes of the primary zooids are definitely related to those of the polyps on which they are placed.

(19.) The "Hauptzooid" of Kölliker is formed at an early stage as a median bud upon the axial polyp, and its function is to discharge water from the colony. The other zooids draw in water from the exterior by the action of the cilia which line their cavities. This is true also of the sexual polyps in their early stages (though this function is entirely lost as they become older). Hence the zooids are physiologically, as well as anatomically, identical with the young polyps; they are, in other words, polyps in a state of arrested development.

The taking in of water is of vital importance to the organism, since the movements of the peduncle, by which the creature creeps, are effected by forcing the water to and fro. In this fact we find, probably, the explanation of the very early appearance of buds upon the axial polyp.

IV.

(20.) The facts of development, so far as they go, indicate the derivation of *Renilla* from a form related to the Bathyptileæ, which probably possessed a horny axis. This view is opposed to that of Kölliker, who considers that *Renilla* is related to the Penniformes only through a primitive simple "*Archiptilum.*"

(21.) The following section contains a brief discussion of the bilateral symmetry, which is strongly exhibited, both in the individual polyps and in the entire colony. It is shown that in both cases the bilateral structure is correlated with a bilateral environment, which indicates a causal relation between the two; and I conclude that the bilateral environment determines the bilateral structure.

(22.) The last section contains a discussion of the polymorphism of *Renilla*. An attempt is made to show that the zooids are probably not degenerated polyps but buds in a state of arrested development, whose direct ancestors never possessed a more highly organised structure than at present.

Other theoretical questions suggested by the investigation are discussed under the various sections in the body of the paper.

THE PHENOMENA PRESENTED BY THE ATMOSPHERE OF VENUS DURING A TRANSIT.

By CHARLES S. HASTINGS.

[Reprinted from "The Sidereal Messenger," February, 1883].

Mr. J. E. Keeler of Allegheny, Penna., has sent me an admirable drawing* of a singular phenomenon observed by him on the 6th of this month at that place, which was also seen independently from the same region by Professor Langley and Mr. Brashear, observing with different instruments. The last named observer has also sent me an interesting sketch of his observation. The phenomenon, briefly described, was a faint patch of light at the limb of *Venus*, exterior to the sun and not symmetrically placed with respect to the immersed segment of the planet. This patch of light, isolated when first seen at perhaps fifteen minutes before second contact, gradually extended around the planet so that a few minutes later it completed the outline. A probable explanation for this phenomenon and others which will be described in the course of this writing, is the object of the article.

The simplest method to employ in acquiring a definite geometrical conception of the problems involved is perhaps the following: Let *C*, the place of the observer, be regarded for the moment as a source of light, and let us consider the course only of such rays as would fall upon the atmosphere of *Venus* and not be stopped by the planet. It is clear that such

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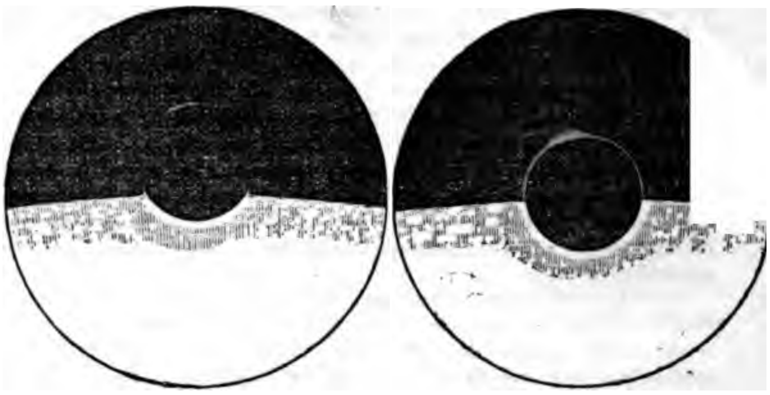
*At the request of Dr. Hastings, of the Johns Hopkins University, I send to the *Messenger* the following account of a singular appearance presented by the ring of light surrounding the planet Venus between the times of first and second contacts, which I observed during the transit of Dec. 5th, but for which I was unable to afford an explanation.

I used a telescope 2¼ inches aperture and 4 feet focus, mounted on an equatorial stand in the open air, and having a positive eye-piece with power of 70, provided with a dark glass of a somewhat greenish tint. A mean time chronometer was placed in a convenient position for noting the time. As soon as first contact occurred, at $20^h\,44^m\,30^s$, I looked for indications of the atmospheric ring around the planet, having been requested by Professor Langley to pay particular attention to the physical phenomena of the transit, but for the first three or four minutes could see nothing of it. Shortly afterwards, however, I caught a feeble glimmer of light, almost star-like in appearance, on the limb of the planet farthest from the sun, which at $20^h\,49^m$ presented the appearance of a curved streak of very faint silvery light extending for a short distance along the margin of the unimmersed portion of the planet's disc. The brightest part of this luminous arc was not directly opposite the sun, but was situated about 20° to the west of a line joining the centres of the sun and Venus. At the same time little horns of light, due, perhaps, to an optical illusion, appeared to rise from the cusps of the sun at the margin of the planet, like the elevated rim of fluid which surrounds an immersed body through capillary action.

As the planet advanced, the arc of light gradually extended and brightened, until at $20^h\,54^m$, or nearly half-way between first and second contacts, the unimmersed portion was completely surrounded by a luminous ring. The light at the place on the margin when it was first noticed, however, much exceeded in brilliancy that of the adjacent portions, the brightest part extending along perhaps 30° of the planet's circumference, and on the western side the luminosity was more evident than on the eastern, when it was as yet barely discernible. The juncture of the luminous arc, first observed with the western cusp of the sun, to which it lay nearest, occurred before the eastern edge became visible. The marginal patch of light now presented the appearance of a local brightening of a continuous ring of light surrounding the planet, and according to my impression at the time, lay without its contour, although thin clouds which had begun to gather, causing the image in the telescope to "boil," rendered a definite conclusion difficult. An independent drawing by Mr. Brashear with a reflector of about six-inch aperture, represents this spot of light as extending within the planet. At $20^h\,57.5^m$ the appearance was still marked, and the ring of light quite brilliant all around the planet. After this my attention was withdrawn from it in preparing to observe the second contact through the fast thickening clouds. At emersion the sky was completely overcast, and observation was impossible.

The phenomenon I have described was also observed by Professor Langley, with the large equatorial of the observatory, temporarily reduced to six-inches aperture, and by Mr. Brashear, of Pittsburgh, with a Newtonian reflector. Professor Langley estimated the centre of the brightest portion to be 30° from the line passing through the centres toward the west, giving a position angle 10° greater than that recorded by me at the time. As the position angle of the planet on the sun when half immersed was about 148°, the mean of these two independent estimates gives a position angle of 178° for the brightest part of the spot on the planet.



VENUS IN TRANSIT, DEC. 5, 1882.

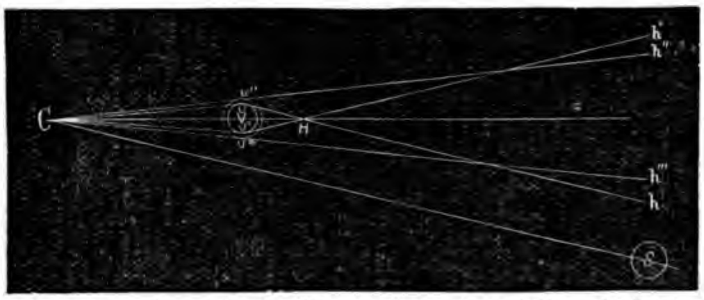
Allegheny Mean Time $20^h\,49^m$, 4.5^m after 1st contact.

Allegheny Mean Time $20^h\,54^m$. 9.5^m after 1st contact.

The appearance of Venus after the spot was first observed, and at $20^h\,54^m$, when nearly half immersed, is represented in the accompanying drawing.

Allegheny Observatory, Dec. 27, 1882. J. E. Keeler.

rays would be contained within a hollow cone having *C*, for an apex and tangent to the two concentric spheres, one the atmosphere of *Venus*, and the other the virtual image of the planet. The diagram shows a meridian section of this double cone. After passing the atmosphere the whole system of rays is contained within a volume of revolution which is best defined by its meridian section $v''\,h''$, $v\,h$, $v'\,h'$, $v'''\,h'''$. One important consideration is readily deduced from the figure. In passing from h'' to h or from h''' to h', the quantity of light received from the side v or v', respectively, constantly diminishes; for if it were constant it would imply that the rays falling between v and v'' must be deflected directly according to their distance below v'', or in other words, that the effect of the atmosphere on a ray of light must increase directly as the depth of its path below the limit of the atmosphere, which is quite contrary to the known laws of variation of atmospheric density. For a similar reason the effect cannot be continually increasing. This conclusion would be true even if $v\,v''$ were not very small compared to Vv, as is assumed, though it could not be established by the reasoning given.



We can now not only determine how *Venus* would appear to an eye placed anywhere within the region just defined, but also, on account of the general principle in optics that the course of a ray is not altered by reversing the direction of propagation of light, we can state first how the planet would appear if the position of the eye and luminous point were interchanged. Thus if the eye is anywhere within the space $v\,H\,v'$, no light from *C* could be seen; anywhere on the axis of the cone beyond H a luminous ring could be seen concentric with the planet; within the cone $h'\,H\,h$, light might be seen on opposite sides of the planet; outside these two regions again, and within the boundary lines, light from one side only could be seen. If the position of the eye and *C* be changed in any case, the appearance is not changed. In the specific case of the effects produced by the sun entering the cone it is necessary to know the dimensions of the various elements indicated in the diagram. Fortunately a famous observation by Professor Lyman of Yale college yields the data necessary, for he found in 1866 that when *Venus* was 108′ from the nearest limb of the sun a complete ring of light might be seen about it. This makes the horizontal refraction of its atmosphere about 45′, or the total deviation of a ray which first passes the planetary surface 1½°; hence the angle $h''\,v\,h$ is 1½°.

From this it readily follows, since $v''\,C\,v'''$ is only 1′ at inferior conjunction, that the angle v H v', is 3°, and from the known diameter of *Venus*, the distance *V*H is about 144,000 miles and *V s* 290,000; but the distance to the sun from the same point is 66,000,000 miles. If then the sun be imagined gradually moving into the space defined by the line *h*H refracted light may be first seen at the point v; this happens when the angle *V C S* is about 108′. This light must be very faint, not only on account of the reasoning concerning the varying rate of refraction within the cone given above, but also because such light must have passed very close to the surface of the planet and have lost much by absorption due to suspended vapors and dust. Indeed, Professor Lyman could only detect this light when his telescope was in the shadow of a cloud or some other distant object.

There is another phenomenon presented by Professor Lyman's observation which, though quite unconnected with the matter concerning us here, might readily lead to confusion, namely, the appearance of *Venus* growing gradually from a crescent of a very little more than 180° compass until its cusps meet. Our reasoning shows that only the light on the opposite side from the sun comes to us by refraction, the rest comes by reflection from the body of the planet, and we see the crescent extending because, owing to the planet's atmospheric refraction, more than half its surface is illuminated by the sun. Just because, however, observation shows that this re-d light does not increase in intensity as the two bodies approach, it *be dismissed from* farther consideration here as it is quite blotted out by our own atmospheric glare long before the beginning of a transit and thus does not contribute to the phenomena which we are studying.

To return to our diagram. As *S* moves onward in the direction before stated the amount of light refracted at v constantly increases by the addition of light which has passed through higher strata, until H *h* becomes tangent to the other limb of the sun, after which all the light refracted from the farther side comes from consecutively more and more elevated strata and consequently grows constantly in intensity. Not until the sun's limb reaches the line $v'''\,h''$, can any light be refracted from the nearer side to the place of the observer at *C*; but this condition corresponds with the epoch of first contact and consequently such refracted light would only appear as slightly increased illumination of the sun immediately adjacent to the planet. This, I think would always escape detection, or at least could not be distinguished from the very strong subjective effect due to the great contrast in brightness between the two bodies, which would be quite similar. The important fact is to be noted that this condition is true of every point of that half of the circumference of the planet nearest the sun, that is, that no point of that half can ever be recognized by refraction. As the sun becomes immersed farther in the cone, the light from the opposite limb not only increases in brightness but also in extent along the circumference of the planet, because the sun, having a large surface, cuts greater and greater portions of our imaginary cones. This progression continues until the limb of the sun comes to the axis of the system of cones at which moment there is a remarkable change in the law of increase of brightness in the atmospheric arc. Up to this moment the light has been constantly growing in intensity at the point opposite to the sun and at the same time extending on both sides towards the cusps of the interrupted limb of the sun; at this instant the light from the most distant region comes from all portions of the sun near the plane of the diagram, with a mean deviation of 16′ and a minimum deviation of ½ minute. The light from the extremities of the planetary diameter tangent to the sun's limb comes only from the single point of the sun which is in line with the centre of the planet. A moment later the light from that portion of the atmospheric ring adjacent to the solar limb comes from all portions of the sun near the chord joining the cusps; but, as is evident, this comes with small deviation and consequent brilliancy. Hence, although the region of the limb remote from the sun is still increasing regularly in brightness, that close to the sun has taken a sudden increment in brilliancy, which must grow until it quite outstrips that of the former region.

We are now prepared to trace all the changes which a telescopic view of *Venus* as she approaches the sun in inferior conjunction would present us. First, the crescent would grow gradually more slender, its horns extending more and more beyond the limits of a diameter until, when the planet is separated little more than 1° from the sun, the cusps would meet and form a ring, thicker, however, on the sunward side. This is the phenomenon observed and described by Professor Lyman. A little later, at a time depending on atmospheric conditions, the planet would totally vanish, in the intense glare surrounding the sun. The next view would be that of the edge more distant from the sun, which would be outlined by an arc of light increasing in brightness and extent with increasing nearness. This the Pittsburgh observers alone seem to have seen, as the observation would demand a purity of sky which was little likely to occur at any place in the United States. One characteristic feature, however, has not been touched upon in our explanation, namely, the non-symmetrical character of the phenomenon; but we find a suggestion of the cause in the demonstrated fact that this light must have passed through relatively low regions of the planetary atmosphere, hence if there were any local differences in transparency due to cloud formations, etc., such a non-symmetry must have resulted. Indeed, if we are guided by analogies drawn from our own atmosphere, we must conclude that such a want of symmetry is more probable than not.

After the centre of the planet has reached the limb of the sun there would result a rapidly growing intensity of illumination of the atmospheric ring near the cusps, which would speedily outstrip the brilliancy of the more distant portion. This phenomenon, which was doubtless seen by most observers much as it was by the writer, I caught just $4^{m}\ 40^{s}$ before second contact, through rather a milky sky, as two slender horns of light shooting out from the solar cusps. One minute and twenty-five seconds later they had met and after that there was a continuous growth in brightness. The phenomena observed after third contact were exactly the same, even the noted times being closely accordant.

JOHNS HOPKINS UNIVERSITY, *Dec.* 23, 1882.

RECENT PUBLICATIONS.

Peabody Institute. Catalogue of the Library of the Peabody Institute of the City of Baltimore. (*Baltimore, The Peabody Institute, 1883*).

By the kindness of Dr. N. H. Morison, Provost of the Institute, the University has received advance sheets of the Parts I, II, (A–B) of the Peabody Library Catalogue.

The laboriousness of the task which has now been going on for fourteen years, may be estimated from the fact that these two letters alone contain nearly 86,000 references, to which C will add about 20,000 more. The system of cataloguing adopted was mainly founded on Panizzi's rules for the British Museum Catalogue, and on the Catalogue of the Boston Public Library, prepared by Mr. Jewett; but several peculiar features have been added.

The dates of the birth and death of each author, so far as ascertainable, are entered under the author's name in the general catalogue; and great pains have been taken to make these dates as complete and accurate as possible.

Another feature is the separation, under subject-headings, of the books from the essays, reviews, and articles in books; the titles of books being placed first, in larger type, and followed by the articles, &c., in a smaller letter; both being alphabetically arranged.

The contents of books are arranged alphabetically, not by the first word, but by the first important word in the heading, wherever it may happen to stand; this word being made conspicuous by bold-faced type. This feature, which is believed to be novel, greatly facilitates the finding of any article in a long list.

Much care has been taken in analysing long sets, such as Migne's great collection, those of Graevius, Bouquet, the Archaeologia, &c., as well as the literary, historical, and antiquarian serials.

Other features of excellence will be noted by those who use this catalogue, which greatly enhances the practical value of this admirable library, by placing in the hands of those who use it, a ready key to its varied treasures.

Craig, T. On the Parallel Surface to the Ellipsoid. (*Journal für die reine und angewandte Mathematik.* Bd. 93. Berlin, 1882).

The surface may be considered as generated by a given point on a straight line which moves so as to be always normal to the ellipsoid in a second given point. In general, every point on a straight line moving so that it is constantly normal to a given surface at a given point of the line describes a parallel surface. The parallel surface may also be conceived as the envelop of a sphere of constant radius, moving with its centre always on the given surface — or as the envelop of a sphere of constant radius which rolls over the entire given surface, *i. e.*, rolls over both sides of the surface The general equation of the parallel to the ellipsoid is obtained in the present paper, but not expanded. The partial differential equation is also written down, and after that the surface is studied by its representation by three equations, giving the coordinates x y z in terms of two independent variable parameters u and v. The sections of the surface are examined, and all the important formulæ necessary for a study of the curvature of the surface are obtained. This paper will be followed by another brief one, treating of the quadrature of parallel surfaces.

Craig, T. A Treatise on Projections. (*U. S. Coast and Geodetic Survey, 1882, pp. 247, 4°*).

"In this paper an attempt has been made to give a sufficiently comprehensive account of the theory of projections to answer the requirements of the ordinary student of that subject. The literature of projections is very large, and its history presents the names of many of the most eminent mathematicians that have lived between the time of Ptolemy and the present day. In the great mass of papers, memoirs, &c., which have been written upon projections there is much that is of the highest value and much that, though interesting, is trifling and unimportant. Thus many projections have been devised for map construction which are merely elegant geometrical trifles. Although in what follows the author has taken up every method of projection with which he is acquainted, he has not thought it necessary in the cases referred to to do more than mention them and give reference to the papers or books in which they may be found fully treated.

As the different conditions which projections for particular purposes have to satisfy are so wholly unlike, it is necessary, of course, to have a different method of treatment for the various cases. Thus no general theory underlying the whole subject of projections can be given. Perhaps the only division of the subject — omitting the simple case of perspective projection — that has ever been fully treated is that of projection by similarity of infinitely small areas. This is a most important case, the general theory of which, for the representation of any surface upon any other, has been given by Gauss. The mathematical difficulties in the way of such a treatment of equivalent projections and projections by development seem to be insurmountable, but certainly offer a most attractive field for mathematical research. The author has attempted to add a little to what is already known on these subjects, but feels that what he has done is of little consequence unless, indeed, it should tempt some abler mathematician to take up the subject and develop it as it deserves. A few of the solutions of simple problems in the paper, it is believed by the author, are new and simpler than any he was able to find in the writings of others. The solution of the problem of the projection of an ellipsoid of three unequal axes upon a sphere by Gauss's method is also believed to be new. With these few exceptions there is no claim to originality in what follows; the attempt having simply been made to present in as simple and natural a form as possible what others have done. The two treatises on projections from which much aid has been obtained are those by Littrow and Germain. Littrow's Chorographie, which appeared in Vienna in 1883, was at that time a most valuable work, but is at the present day too limited in its scope to be of very much use to the student. Unquestionably the most important treatise on the subject at this time is Germain's "*Traité des projections,*" which contains an account of almost every projection that has ever been invented. The author is under much obligation to this work, both for references to original sources and for solutions of particular problems. In cases where processes or diagrams are taken from this work that are by the author supposed to have been original with M. Germain, special mention of them is made in the text; when, however, Germain has drawn from earlier sources, no mention is made of his book, but as far as possible references to the original papers are given. The opening brief chapter on conic sections has been taken in great part from Salmon's Conic Sections. The object of that chapter is only to give in a simple manner some of the more important and elementary properties of the curves of the second order, so that convenient reference could be made in the subsequent part of the paper to the various formulae connected with these curves, and also simple means given for constructing them. At the request of Superintendent Carlile P. Patterson the paper has been divided into two parts. The first part contains the mathematical theory of projections, while the second part contains merely such a sufficient account of the various projections as will enable the draughtsman to construct them."—*Extract from the Preface.*

Morris, G. S. Kant's Critique of Pure Reason. A Critical Exposition. (*Chicago: S. C. Griggs & Co., 1882, pp. xvi, 272*).

The author aims in this volume to exhibit succinctly the substantial contents of Kant's *Kritik der reinen Vernunft*, and to furnish a critical estimate of its philosophical value and significance. To this end, in the Introduction, the universal nature and historic results of philosophic inquiry are briefly sketched; and then, in the body of the work, the exposition proceeds by a way intended to indicate (1) the starting-point of Kant's *Kritik*, (2) the goal of demonstration actually reached in the *Kritik*, and (8) the further goal, not reached in the *Kritik*, but to which the latter both positively and negatively points.

This volume was the first one to appear in a series of "German Philosophical Classics for English Readers and Students," under the general editorial direction of the author. Beside it, there has already been published in the same series "Schelling's Transcendental Idealism," by Prof. John Watson, of Queen's University, Kingston, Ontario; and the following are in preparation:

Leibnitz's New Essays. Prof. G. H. Howison.
Kant's Ethics. President N. Porter.
Kant's Aesthetics and Natural Theology (Kritik der Urtheilskraft). Prof. Robert Adamson, Victoria University, Manchester, England.
Fichte's Science of Knowledge. Prof. C. C. Everett, Harvard Divinity School.
Hegel's Logic. Dr. W. T. Harris.
Hegel's Philosophy of Religion. Principal A. M. Fairbairn, Airedale College, Yorkshire, England.
Hegel's Aesthetics. Prof. J. S Kedney.

The series, according to the present plan, will be completed with the addition of a volume on Hegel's Philosophy of History and the State.

Rowland, H. A. Relazione Critica sulle varie determinazioni dell' Equivalente Meccanico della Caloria. (*Opera Premiata dal Reale Istituto Veneto, Atti, Serie V, T. VII, pp. 120, 8°.*)

This is the Italian translation of a paper sent to Venice in March, 1880, in response to an announcement of the Venetian Institute that a prize would be given for the best essay on the subject. It embodies in part a revision of Rowland's communication (published by the American Academy of Arts and Sciences) on his own investigations, and also critical and historical comments on previous determinations of the same constant.

The circumstances which led to the award are thus narrated in the report of the committee to whom the competing manuscripts were referred.

[*Translation.*]

Four years ago our Institute announced a competition for a prize of 1500 lire on the following subject:

"To discuss in detail the determinations hitherto made of the mechanical equivalent of heat; to investigate the causes of the remarkable differences which are found in the results; to point out what is the most probable value that can be obtained from these results; and to determine the equivalent itself by new experiments according to the method which the competitor shall have proved to be the most exact."

Two competitors presented themselves, one with a short memoir in Italian, inscribed with the motto: "*Provando e riprovando;*" the other with a voluminous English manuscript which bore the motto: "*Veritas vos liberabit.*"

The examination of these two memoirs was intrusted by you to the committee which has now completed its task.

. . . . A memoir of much greater breadth and importance is contained in the English manuscript inscribed "*Veritas vos liberabit.*"

. . . . Your committee is happy to be able to state that the author has completely exhausted the first portion of the subject, and that too in such a way that it would be impossible to imagine a better treatment of the subject. The second part, it is true, is wanting. In order to justify this omission it will be well to recall a fact relative to the preparation of this memoir, which was mentioned to the Institute by our Secretary at our meeting last year. He said in fact that within the time laid down for the competitions of that year there had come from Baltimore an English memoir with the motto "*Veritas vos liberabit,*" and he expressed the earnest wish that he might be able to communicate with the unknown author to let him know that the competition did not expire before March 31, 1881.

A letter which the author sent last year together with the memoir proved unquestionably that he was led into error not only with regard to the time when the competition closed, but also with regard to the existence of the second part of the subject.

"It may be, he says in his letter bearing the date of March 11, 1880, that I have not fully satisfied the formal conditions of the competition; but in spite of all my researches in Washington and in Boston, the only information which I have been able to obtain is that given by the English paper "*Nature,*" No. 13, for January, 1880."

Your committee took pains to look at the announcement given by *Nature*, which is worded as follows: "The Institute of Venice opens a competition for a prize of L. 1500 for a detailed description of the determinations hitherto made of the mechanical equivalent of heat, for the investigation of the causes, etc. Limit for the competition, March 31, 1880."

Two reasons then have contributed to prevent the author from entering on any new experiments. The principal cause was that he did not know that the subject set for competition included the performing of new experiments. A second and sufficiently powerful reason consisted in the shortness of the time, since the author had only a single month at his disposal. It would have been impossible for any one in so short a time to present a work so extended, profound, and exhaustive, if the author had not already long busied himself with investigations analogous to those required by the subject proposed by our Institute, and had not already had at his hand all the materials necessary for its solution.

This fact also can be explained to a certain extent by your committee.

In June, 1879, Henry A. Rowland, Professor of Physics in the University of Baltimore, laid before the American Academy of Arts and Sciences a voluminous and very important memoir "on the mechanical equivalent of heat with subsidiary researches on the variation of the mercurial from the air thermometer, and on the variation of the specific heat of water." This memoir was printed in the Proceedings of that Academy and also separately in Cambridge in the beginning of the year 1880.

Now the memoir presented to our competition contains a large portion of Rowland's memoir. Let it not, however, be believed to be a case of plagiarism. Our author quotes Rowland with scrupulous exactness, both when he gives his actual words and also when he only gives the substance of one of his paragraphs. Besides there are many variations.

The resemblance between the portions borrowed from Rowland and the portions introduced by our author is so great, that it would seem as though Rowland himself, wishing to conform to the subject proposed by our Institute, had cast anew his former work, arranging it in a different order agreeably to the requirements of the subject, and making in it such emendations and corrections as seemed to him necessary for his purpose.

However this may be, our anonymous author in the last part of his memoir finds the mean value given by each method, assigning a varying importance to the determinations of different investigators, and then finds the mean value of these means themselves, each estimated proportionately to the varying excellence of the method by which it was obtained. By the method of the theory of gases he obtains the mean value of 430.7; by means of the heat generated by electric currents the value of 428.4; from the experiments performed by Joule in 1850, he obtains the mean value of 426.4; and from Rowland's experiments (1879) the value 427.7; and giving an importance equal to 1 to each of the first two methods, an importance equal to 3 to the third and fourth method, and an importance equal to 10 to the last method, he reaches the conclusion that, at the latitude of Baltimore and under a temperature of 13.9° C., the mechanical equivalent of heat is expressed by 427.62 kilograms, a value almost identical with that found by Rowland, and therefore almost identical with the value deduced from the other determinations.

Considering that the author of the memoir "*Veritas vos liberabit*" has admirably solved the first part of the subject, *i. e.* the most important part and the one most useful to science, and giving due weight to the reasons owing to which the second part could not be done, your committee is of opinion that this memoir deserves the prize, and proposes therefore that the Institute should bestow on the author the sum of L. 1500, the amount of the prize announced for the subject of this competition.

DOMENICO TURAZZA,
ANTONIO PAZIENTI,
FRANCESCO ROSSETTI.

The conclusions of the committee having been approved by the Institute, the note of the memoir bearing the motto "*Veritas vos liberabit*" was opened, and the author was found to be Prof. Henry A. Rowland, of Baltimore.

Jameson, J. F. Montauk and the Common Lands of Easthampton. (*Magazine of American History, April, 1883, pp. 7, 8°.*)

This paper was read before the University Historical and Political Science Association. (April, 1882), and an abstract is given on page 208 *University Circular, No.* 15.

Harris, J. Rendel. New Testament Autographs. (*Baltimore, 1883, pp. 54, 8°, 4 plates; 50 cents*).

Mr. Harris has shown by arguments of mathematical cogency that the Vatican and Sinaitic MSS. were copied from originals with pages of a different size: that the *στίχος* of the Vatican MS. was identical with that which M. Ch. Graux proved to be the normal length of the dactylic hexameter verse; while that of the Sinaitic MS. was as clearly of a length corresponding to the iambic senarius. In this way he establishes what he designates as the V-page and the S-page; and having secured these standards he proceeds to apply them to the solution of various questions of extreme interest. The critical path thus opened by Mr. Harris is likely to lead to many important results, but it has of course as yet been very little explored. All however who care for questions of New Testament criticism will be interested in knowing that the passage in St. John's Gospel concerning the Woman taken in Adultery, which even conservative critics have found it hard to defend where it stands, occupied precisely four V-pages—here reproduced in a conjectural facsimile, which shows the texture of the papyrus and the joining of the separate sheets—which must have been lost from the original document before it came into the shape represented by Codex B; and that when restored they were inserted in a place which they did not previously occupy: and it is further shown that the passage should probably be placed at the end of the fifth chapter. It is not only in the settlement of the New Testament text that Mr. Harris's method is likely to prove fruitful, but also in determining similar problems in regard to other ancient writings; and it is shown in fact in this essay that it would be possible to print the letters of Pliny approximately as they must have appeared in their autographs.

The interest attaching to these investigations induced the Editor of the *American Journal of Philology* not to postpone the publication of an account of them till room could be found for it in the regular numbers of the *Journal*, but to issue a supplementary part devoted expressly to it. In this way too, it was expected that the subject might be brought to the attention of many who take a deep interest in the questions and methods of New Testament criticism, but do not regularly see the *Journal* itself. The nature of Mr. Harris's method can be properly appreciated only by a study of the essay at length; and indeed it would be impossible in this notice to give even an approximate impression of the cumulative force of the argument, illustrated as it is by tables and lithographed reproductions of the probable pages of the original autographs.

Gilman, D. C. James Monroe. (*American Statesman Series, Boston: Houghton, 1883, pp. 300, 12°*).

This volume, which was prepared at the request of the editor of the series, presents some fresh information in regard to James Monroe derived from an examination of his unpublished writings. In the appendix there is an elaborate Bibliography, by J. F. Jameson, Ph. D., relating to the Monroe Doctrine, as well as to the life of Monroe.

Adams, H. B. Saxon Tithingmen in America. (*University Studies in Historical and Political Science, No. IV, pp. 23, 8°; 25 cents*).

This paper was read before the American Antiquarian Society, October, 1881, and before the University Historical and Political Science Association, December, 1881. An abstract is given on p. 176 of *University Circular, No.* 18.

Bemis, E. W. Local Government in Michigan and the Northwest. (*University Studies in Historical and Political Science, No. V, pp. 25, 8°; 25 cents.*)

This paper was read before the University Historical and Political Science Association, (January, 1881), and before the American Social Science Association, (September, 1882). An abstract is given on p. 130 of *University Circular, No.* 10.

Ingle, E. Parish Institutions of Maryland. (*University Studies in Historical and Political Science, No. VI, pp. 48, 8°; 40 cents.*)

This paper was read before the University Historical and Political Science Association, (May, 1882). and an abstract is given on page 238 of *University Circular, No.* 17. It is also published in an abridged form in the Magazine of American History, April, 1883.

SYNOPSIS OF THE RECENT SCIENTIFIC JOURNALS

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American Journal of Philology. Edited by PROFESSOR GILDERSLEEVE. *Vol. III. Whole No.* 12.

Article I.—Eggeling's Translation of the Çathapathabrāhmaṇa, by WILLIAM DWIGHT WHITNEY.

The Brahmaṇas come next after the Vedic hymn texts. They are products of the schools of priests engaged in the practice and propagation of the sacrificial ceremonies and in the study of their value and application. They describe the ceremonial and give the dogmatic basis of the vast and intricate science of sacrifice. We have here one of the aberrations of the human mind, but one which is of a high interest and necessary to be understood, and the more as it is a step in the religious development of a great and gifted people. Moreover the Brâhmaṇas are the oldest body of Indo-European prose, of a generally free, vigorous, simple form, affording valuable glimpses at the primitive condition of unfettered Indo-European talk, which part of their value has been especially brought out by Delbrück. And their language is of an older cast than the classic Sanskrit, being in many respects intermediate between the latter and the yet older Vedic dialect. For these reasons, and in spite of their tedious inanity, they are full of interest, almost of charm to the special student, and Professor Eggeling's translation is a highly interesting and important volume, and in Professor Whitney's judgment, by far the most legitimate and acceptable contribution to the world's knowledge of the religious history of ancient Brahmanical India made in Müller's series of the Sacred Books of the East.

The Brâhmaṇas are all joint survivals out of one age of production and tradition; but another generation of scholars will pass, in all probability, before they will be sufficiently worked up to allow of our holding definite and defensible views as to their history. Not all of them are yet accessible in print, and the enterprise of Professor Eggeling is by far the most considerable that has been undertaken in this department, and yet the present stout volume contains just one-fifth of the Brâhmaṇas. Professor Eggeling has executed his task very well. He is a competent translator in both departments of the work—in general accuracy of scholarship and familiarity with the Brâhmaṇa style and in comprehension of the processes of the ceremonial and knowledge of its technical vocabulary. [The rest of Professor Whitney's article is taken up with a detailed criticism of the translation].

Article II.—On the Locality to which the Treatise of Palladius *De Agricultura* must be assigned, by J. RENDEL HARRIS.

[This paper was read before the Johns Hopkins Philological Association, Oct. 6, 1882, and an abstract may be found on p. 6 of the *Circular* for Nov., 1882].

Article III.—On some Points of Usage in English, by FITZEDWARD HALL.

This essay was suggested by some remarks of Professor Short in the *American Journal of Philology* (*Vol. III, pp.* 141-169) on the English of the Revised New Testament. Dr. Hall has presented a large collection of singular verbs with compound subjects, ranging from the fifteenth century to the nineteenth, a long list of names of rivers used without the article, and a number of examples of duplicated prepositions such as we find in "cast out the mote out of," with incidental notes on other points of usage.

Article IV.—Studies in Pindaric Syntax, by the EDITOR.

An abstract of this paper is given on p. 68 of this *Circular*.

Article V.—On a Probable Error in Plutarch, Per. c. 23, by C. D. MORRIS.

[This paper was read before the Johns Hopkins Philological Association (Dec. 8, 1882), and an abstract will be found in the *Circular* for Feb., 1883, p. 52].

In the *Notes*, Professor J. M. HART brings forward confirmation of his view expressed in the *American Journal of Philology* (*I*, 442), that in the Leabhar Breac the commentator on the canon of the mass presupposes a commingling of the elements in the chalice by pouring the wine upon the water, which symbolized the adding of the divine nature of Christ to humanity; Professor F. D. ALLEN publishes a short Aeolic inscription from Assos, and Professor H. E. SHEPHERD cites from the writings of J. C. Calhoun the word 'occlude,' which is marked as obsolete in all our American dictionaries, [and which is used every day of the world by physicians].

This number contains further *Reviews* of *Haupt's Akkadische Sprache*, by Professor J. F. MCCURDY; of *Zahn's Cyprian von Antiochien*, by Professor J. M. HART; of *Monro's Homeric Grammar*, by Professor T. D. SEYMOUR; of *Kluge's Etymologisches Wörterbuch*, by Professor S. PRIMER; of *Horstmann's Altenglische Legenden*, by Professor JAMES M. GARNETT; of *Hauler's Terentiana*, by Dr. M. WARREN; of *Seuffert's Deutsche Litteraturdenkmale*, by Dr. JULIUS GOEBEL, and of *Bücheler's Petronius*, by Professor ROBINSON ELLIS.

The *Reports* give abstracts of *Fleckeisen's Jahrbücher*, *Revue de Philologie*, *Mnemosyne*.

In the *Correspondence* Dr. M. BLOOMFIELD and Rev. L. H. MILLS give a detailed account of the work of the latter scholar on the Gâthâs.

This is the last number of the third volume. The offer of the management to reduce the price of *Vols. I* and *II* still holds. Either of these volumes can be had for $2 until further notice. *Vol. III*, which contains not only the four regular numbers (522 pp) but a supplement of 54 pages with illustrations, may be had at the regular subscription price ($3). THE MANAGEMENT HAS DETERMINED TO KEEP ONLY A SMALL RESERVE AFTER SUPPLYING ACTUAL SUBSCRIBERS, AND APPLICATION SHOULD BE MADE WITHOUT DELAY TO THE EDITOR, P. O. DRAWER 2, BALTIMORE, MD.

Vol. IV, 1, (Whole No. 13) of the AMERICAN JOURNAL OF PHILOLOGY is in press. It will contain articles on the *Color System of Vergil*, by T. R. PRICE (see *Circular*, *No.* 15, *p.* 205), on the *General Theory of Greek Accentuation*, by M. BLOOMFIELD (see *Circular*, *No.* 21, *p.* 66), *Etymological Notes*, by J. P. POSTGATE, and minor communications by H. NETTLESHIP, M. WARREN, H. E. SHEPHERD, with a number of short *Reviews* and *Reports* of *Hermes*, *Mnemosyne*, *Germania*, etc.

American Journal of Mathematics. Edited by PROFESSOR SYLVESTER. *Vol. V, No.* 3.

Article I.—On the Non-Euclidean Geometry (*conclusion*), by W. E. STORY.

Article II.—On Cubic Curves, by F. FRANKLIN.

Article III.—On the Solution of the Differential Equation of Sources, by J. HAMMOND.

Article IV.—Bibliography of Bernouilli's Numbers, by G. S. ELY.

Article V.—On Division of Series, by REV. JOHN HAGAN, S. J.

Article VI.—Sur le Développement des Fonctions Rationelles, by REV. FAÀ DE BRUNO.

Article VII.—Tables of Generating Functions Reduced and Representative by certain Ternary Equations, by J. J. SYLVESTER.

Article VIII. A Constructive Theory of Partitions arranged in Three Acts, an Interact, and an Exodion, by J. J. SYLVESTER.

American Chemical Journal. Edited by PROFESSOR REMSEN. *Vol. V, No.* 1. (*April*, 1883).

Article I.—On some Reductions with Zinc and Ammonia, by W. G. MIXTER.

Article II.—On the Distribution of Arsenic in a Human Body, by R. H. CHITTENDEN.

Article III.—Hydrated Carbon Disulphide, by F. P. VENABLE.

Article IV.—An Isopicraminic Acid, by CHARLES W. DABNEY, JR.

Article V.—Piscidia, the Active Principle of Jamaica Dogwood (Piscidia Erythrina), by EDWARD HART.

Article VI.—Estimation of Chlorine, Sulphuric Acid, and Chromium in the presence of Organic Matter, by CHARLES T. POMEROY.

Article VII.—Methods of Analysing Samarskite, by J. LAWRENCE SMITH.

Article VII.—A Method for the Preparation of Carbon Monoxide, by L. P. KINNICUTT.

Reviews and Reports.

The Present Condition of the Soda Industry, by W. WELDON.

Recent Researches on the Pyridine and Quinoline Bases.

Researches on Caffeine.

The number closes with various notes by F. H. STORER, W. A. NOYES, J. R. DUGGAN, and others.

Studies in Historical and Political Science. Edited by DR. H. B. ADAMS. *Nos.* 4, 5, 6.

See list of Recent Publications, p. 82.

CORRESPONDENCE.

Extracts of Letters to Professor Sylvester, *from* Mr. J. Hammond, of Buckhurst Hill, Essex, England.

January 23d, 1883.—When I saw your question in the *Educational Times*, on a succession of integers, etc., No. 7219, I thought you had been trying the *American Journal* Prize Question, but did not think that either a proof or disproof could be obtained that way, especially when I considered the difficulty of finding a rule to fit the case of weight 11, in which the Postulate holds for Quantics of all orders to infinity, with the single exception of the Septimic, viz: for the Quintic and Sextic there are ground-forms of deg-order (5.3)(5.8) but no syzygants of the same type, for the Septimic both a ground-form and syzygant of deg-order (5.13), for the Octavic and all superior Quantics syzygants but no ground-forms of the same type. This result is, as you observe, a startling one; my first impression, when I made the discovery at the end of November, was that there was some flaw in my reasoning; when I could find none, I had some misgivings as to the correctness of the printed expressions for the generating functions given in the *Journal*, and it was only after three days' consideration, and after counting the partitions more than once, to verify my result, that I was so far convinced of its truth as to venture to send it for publication. My second note followed, the results announced in which are not yet arranged as I should wish them to be, but they will lead to an *automatic method of tamisage*, which will be found to save labor. By this method I have performed the tamisage for Quantics of all orders up to 8, and found the same results as printed in the *Journal*. I have not tried it on higher Quantics, as I consider that this gives a reasonable assurance of the correctness of the method. . . . .

Since then I have resumed a subject that was interrupted by the Prize Question, viz.: the Symmetric Functions of the roots of an equation; my first imperfect views on this subject are printed in the Mathematical Society's proceedings. In the paper I am now writing, as a sequel to this, is a general expression for Σa^n and a proof of Prof. Cayley's law of symmetry given at the end of the tables in Salmon. . . . .

All my papers have been solutions of doubts and difficulties that presented themselves to my mind, and, I believe, have been more instructive to myself than to anyone else. The case of the Prize Question has been no exception to this; I have learned more in solving it than anyone else can in reading my solution.

Starting with a bare knowledge of the meaning of the words "Ground-form" and "Syzygant," obtained from the *Journal*, the method of obtaining Ground-forms given in the *Journal* and that briefly mentioned in Salmon, my first difficulty was how to obtain syzygants without assuming the Fundamental Postulate. After getting over this, and seeing how many of the syzygants may be obtained (all, if one could examine each particular case), the question deluded and deceived me for some months, when, to my surprise, I found that in one simple case I obtained a syzygant where the Postulate said there was none. . . . .

February 3, 1883.—I seize pen and paper to communicate a discovery I have this instant made. There is a ground-form for the Binary 9-ic of deg-order (5.19).

The number of linearly independent forms is 7; the compound forms are (1.9)(4.10), (1.9)(4.10), (2.2)(3.17), (2.6)(3.13), (2.10)(3.9), (2.10)(3.9) (2.14)(3.5) also 7 in number; and the syzygant is $C_9 Q_4 - C_5 Q_8 = V\,(^*)$ with the notation of my paper.

This form I found by searching, the former was obtained by chance. . . .

February 5, 1883.—In continuing my search for cases of co-existence of Ground-form and Syzygant, I have to-day found three new cases, making, with my former two, five in all, viz.:

$$\left.\begin{array}{l}\text{The case (5.13) for the 7-ic}\\ \text{" (5.19) " 9-ic}\end{array}\right\}\text{already given.}$$

2 of deg order (5.25) for the 11-ic,
1 " (5.15) " 9-ic.

To give the reasoning would, in each case, be only to repeat the reasoning of the last article of my paper on the Solution of the Differential Equation.* The Syzygants of the respective types are all of the same form, viz:

$$\begin{aligned} Q_4C_7 - C_5Q_6 &= V\,(^*)\ (5.18) \text{ for 7-ic,}\\ Q_4C_9 - C_5Q_8 &= V\,(^*)\ (5.19) \text{ for 9-ic,}\\ Q_4C_{11} - C_5Q_{10} &= V\,(^*)\ (5.25) \text{ for 11-ic,}\\ Q_6C_9 - C_7Q_8 &= V\,(^*)\ (5.25) \text{ for 11-ic,}\\ &\qquad\text{and (5.15) for 9-ic.}\end{aligned}$$

This last case rather staggers me, as it is a case where (if the tables in the *Journal* are correctly printed) there are two ground-forms found by tamisage, which shows that tamisage will not give all the ground-forms that correspond to the first positive block of the numerator of the Representative Generating Function.

I do not think, however, that this will destroy my proof that all the ground-forms found by tamisage come from the first positive block.

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*I add, to prevent misconception, that I have not gone into the *realistic* reasoning of any case except the original (5.13), all the others were obtained by *idealistic* reasoning.

[It is, perhaps, unnecessary to add that here, as in my paper,

$$\begin{aligned} Q_{2m} &= a_0a_{2m} - 2ma_1a_{2m-1} + \dots\\ C_{2m+3} &= a_0^2a_{2m+1} - \&c\\ V &= a_0].\end{aligned}$$

March 8, 1888.— . . . When I first wrote (December 2) I believed equation (9) of my paper to be my own, but afterwards found that you had given the same result applied to a system of quantics instead of a single quantic only on p. 119, Vol. I, of the *American Journal*. Something very much like it is also given in *Hargreave's Essay on the Resolution of Algebraic Equations* (1866), where, on p. 8, he says: "The linear transformation shows not only that the discriminant of a quantic, but that every combination of the roots or coefficients of a quantic whose vanishing denotes the condition or one of the conditions of some system or systems of equalities between the roots, (for example, all the leading Sturmian coefficients of the quantic), admits of being expressed in terms of the $(n-1)$ quantities (12), (13), . . . , ($1n$).

These $(n-1)$ quantities of Hargreave's are all of them differenciants, but only two of them, (12) and (13), are protomorphs; they form a series in which the degree and weight are equal, since their first terms are respectively a_1^2, $2a_1^3$, $3a_1^4$. $4a_1^5$, ... The use of these seems to complicate Hargreave's results unnecessarily; for example, on p. 9, he says: "The discriminant of the quartic admits of being placed in the form

$$27\left((12)^3 + (12)(14) - (13)^2\right)^2 - \left(3\,(12)^2 - (14)\right)^3.$$

I wish to make one short remark on the use of generating functions which will, I believe, bring your results in Vol. V. of the *Journal* into complete accordance with mine. In any case where generating functions are used there is a liability of error arising from the fact that $1 - 1 = 0$, both units having disappeared and left no trace of their former existence. Now it has been conclusively proved (*American Journal*, Vol. V., p. 117) that compound syzygies and ground-forms of the 7th degree and the same weight coexist for any quantic whose order is sufficiently great, and the error about to be proved does not affect this.

The error in question is on p. 108,* where the number of syzygies of degree 5 (ground-syzygies) is said to be finite when they are really infinite, and consequently ground-forms and ground-syzygies coexist, for any quantic whose order is sufficiently great of degree 5 and any odd weight = or > 15.

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*I was aware after the discovery of the Falsity of the Postulate (which had been tacitly assumed as correct by almost all if not all previous writers), that the results, to one of which Mr. Hammond alludes, were open to question, and had contemplated making a remark to that effect in the 5th Section of my memoir, on Subinvariants.

The last few months will be a period forever memorable in the records of Mathematical Science, as one in which came to light the three great discoveries of a proof being possible of the impossibility of the Quadrature of the circle, the existence of an Assymptotic Value (by Mr. Halphen) to the sum of the logarithms of the inferior primes to a given number, and the Falsity of the ordinarily assumed Postulate in the Theory of Invariants.

is in effect given in Serret's Algebra, and the solution is wonderfully simple. Write A, B, $C = ac - b^2$, $ad - bc$, $bd - c^2$, $\lambda = \sqrt{-\tfrac{1}{3}}$, Ω the discriminant $a^2d^2 +$ &c., then the values are

$$\alpha = \frac{-\lambda\sqrt{\Omega} + B}{2\lambda\sqrt{\Omega}},\ \beta = \frac{2C}{2\lambda\sqrt{\Omega}},\ \gamma = \frac{-2A}{2\lambda\sqrt{\Omega}},\ \delta = \frac{-\lambda\sqrt{\Omega} - B}{2\lambda\sqrt{\Omega}},$$

giving $\alpha\delta - \beta\gamma = 1$ and $\alpha + \delta = -1$, whence $\alpha^2 + \delta^2 + \alpha\delta + \beta\gamma = 0$, the condition for $\dfrac{\alpha x + \beta}{\gamma x + \delta}$ periodic of the third order $\phi^3 x = x$. There is a good deal that is pretty in the working out.

2°. Riemann's theory of the bitangents of a plane quartic — see my addition at end of Salmon's H. P. C. — but a slight change of notation gives an additional symmetry to the solution; take $a_1, b_1, c_1, a_2, b_2, c_2, a_3, b_3, c_3$, arbitrary $f_1 = \dfrac{1}{a_1}$, &c., then the first three of the following four equations determine ξ, η, ζ as linear functions of x, y, z, and it is possible to determine and that in one way only a_4, b_4, c_4, and f_4, g_4, h_4, ($f_4 = \dfrac{1}{a_4}$, &c.) so as to satisfy the fourth equation

$$\begin{aligned} a_1x_1 + b_1y_1 + c_1z_1 + f_1\xi_1 + g_1\eta_1 + h_1\zeta &= 0, \\ a_2x_2 + b_2y_2 + c_2z_2 + f_2\xi_2 + g_2\eta_2 + h_2\zeta &= 0, \\ a_3x_3 + b_3y_3 + c_3z_3 + f_3\xi_3 + g_3\eta_3 + h_3\zeta &= 0, \\ a_4x_4 + b_4y_4 + c_4z_4 + f_4\xi_4 + g_4\eta_4 + h_4\zeta &= 0, \end{aligned}$$

and this being so, the equations of all the 28 bitangents of the curve

$$\sqrt{x\xi} + \sqrt{y\eta} + \sqrt{z\zeta} = 0,$$

can be expressed very simply in terms of x y, z, ξ, η, ζ, and the constants.

In consequence of the change it appears that six of the bitangents can be expressed each of them in a double four, viz , the two equations

$$\frac{x}{b_1c_1 - b_2c_2} + \frac{y}{c_1a_1 - c_2a_2} + \frac{z}{a_1b_1 - a_2b_2} = 0,$$

and

$$\frac{\xi}{g_3h_3 - g_4h_4} + \frac{\eta}{h_3f_3 - h_4f_4} + \frac{\zeta}{f_3g_3 - f_4g_4} = 0,$$

represent one and the same double tangent (in fact we get each of these equations, and so in all $22 + 6 + 6, = 34$, 6 double tangents too many, if the two were not identical), but the *a posteriori* verification of the identity of the two equations is not by any means easy.

Since this writing the idea flashed across me that the *same formulae* apply to the 16-nodal quartic surface, viz., if $x, y, z, \xi, \eta, \zeta$, are linear functions of four coordinates (of course these may be x, y, z, ξ) such that identically

$$\begin{aligned} &x + y + z + \xi + \eta + \zeta + = 0, \\ &ax + by + cz + f\xi + g\eta + h\zeta = 0, \end{aligned} \qquad af = bg = ch = 1.$$

then the quartic surface $\sqrt{x\xi} + \sqrt{y\eta} + \sqrt{z\zeta} = 0$, has the 16 singular tangent planes

$$\begin{aligned} &x = 0,\ y = 0,\ z = 0,\ \xi = 0,\ \eta = 0,\ \zeta = 0, \\ &\quad x + y + z = 0, \quad ax + by + cz = 0, \\ &\quad \xi + y + z = 0, \quad f\xi + by + cz = 0, \\ &\quad x + \eta + z = 0, \quad ax + g\eta + cz = 0, \\ &\quad x + y + \zeta = 0, \quad ax + by + h\zeta = 0, \end{aligned} \qquad \begin{aligned} &\frac{x}{1 - bc} + \frac{y}{1 - ca} + \frac{z}{1 - ab} = 0, \\ &\frac{\xi}{1 - gh} + \frac{\eta}{1 - hf} + \frac{\zeta}{1 - fg} = 0, \end{aligned}$$

i. e., it is a 16-nodal surface. I have identified the form with one which I gave some time ago in the *Proc. L. M. S.*

I have just received No. 20 of the *J. H. Circular*: . . . "infinity" or "pole" is the French expression for your infinity-root — a word which occurred to me instead of the "essential singular point" of Weierstrass, *i. e.*, a non-algebraical infinity [such as $x = 0$ for $\log x$] is "chasm" — a function in general has thus roots, poles, and chasms.

[*Extract from a letter of* Professor Cayley *to* Dr. Franklin, *read at the meeting of the University Mathematical Society, February 21, 1883*].

It is I think noticeable that your theory* in connexion with the product $\overline{1-x}\ \overline{1-x^2}\ \overline{1-x^3} \ldots$ *does something more* than group the partitions into pairs—in addition to the existing division $E + O$ of the partitions into even and odd, it establishes a new division $I + D$ of the same partitions into increasible and decreasible. There is thus a fourfold division

$$\frac{EI \mid OI}{ED \mid OD}.$$

For instance, if $N = 10$, the arrangement is

$$\frac{8 + 2,\ 7 + 3,\ 6 + 4 \mid 10,\ 5 + 3 + 2}{9 + 1,\ 4 + 3 + 2 + 1 \mid 7 + 2 + 1,\ 6 + 3 + 1,\ 5 + 4 + 1}$$

where the EI and OD each taken in order pair with each other, and similarly the OI and ED.

Of course for the exceptional numbers $N = 1, 2, 5, 7, 12, 15$, &c., there is just one partition which is neither I nor D; and according as it is O or E we have in the product a coefficient -1 or $+1$.

A Note from Professor Sylvester.

March 30, 1883.

My attention has been called to an appearance of contradiction between an erratum which I inserted on page 46 of the *Circulars* and a remark of mine in a previous number (*No.* 15, *May*, 1882). I think the seeming discrepancy will disappear if the point I desire to make is duly apprehended. I wished (as I still wish) it to be understood that it is Mr. Peirce's statement and not mine that the "forms" in question can be derived from his Logic of Relatives. I certainly know what he has told me and should attach implicit credit to any statement emanating from him, but have not the knowledge which would come from having myself found in his Logic of Relatives the forms referred to: as previously stated I have not read his Logic of Relatives and am not acquainted with its contents.

J. J. S.

A Communication from Mr. Peirce.

Readers of Professor Sylvester's communication entitled *Erratum* in the last number of these Circulars have perhaps inferred that my conduct in the matter there referred to had been in fault. Professor Sylvester's *Erratum* relates to his "Word upon Nonions," printed in the *Johns Hopkins University Circulars No.* 17, *p.* 242. In that article appears this sentence: "These forms [*i. e.* a certain group of nine Forms belonging to the algebra of Nonions] can be derived from an algebra given by Mr. Charles S. Peirce, (*Logic of Relatives*, 1870)." The object of Professor Sylvester's "*Erratum*" would seem to be to say that this sentence was inserted by me in his proof-sheet without his knowledge or authority on the occasion of the proof being submitted to me to supply a reference, and to repudiate the sentence, because he "knows nothing whatever" of the fact stated.

But I think this view of Professor Sylvester's meaning is refuted by simply citing the following testimony of Professor Sylvester himself, printed in the *Johns Hopkins University Circulars*, *No.* 15, *p.* 203.

"Mr. Sylvester mentioned . . . that . . . he had come upon a system of Nonions, the exact analogues of the Hamiltonian Quaternions . . . Mr. Charles S. Peirce, it should be stated, had to the certain knowledge of Mr. Sylvester arrived at the same result many years ago in connection with his theory of the *logic of relatives*; but whether the result had been published by Mr. Peirce, he was unable to say."

This being so, I think that on the occasion of Professor Sylvester's publishing these forms I was entitled to some mention, if I had already published them, and *a fortiori* if I had not. When the proof-sheet was put into my hands, the request made to me, by an oral message, was not simply to supply a reference but to correct a statement relating to my work in the body of the text. And I had no reason to suppose that having thus submitted his text to me, Professor Sylvester would omit to look at his proof sheet after it left my hands to see whether or not he approved of such alteration as I might have proposed. At any rate, when from these causes Professor Sylvester's "Word upon Nonions" had been published with the above statement concerning me, would it have been too much to expect that he should take the trouble to refer to my memoir in order to see whether the statement was not after all true, before publicly protesting against it?

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* *Comptes Rendus*, XCII, p. 448, 1880.

thus obtained are obviously independent and obviously form a group. Thus the problem is solved by a method applicable to any other quadrate.

My father, with his strong partiality for my performances, talked a good deal about the algebra of nonions in general and these forms in particular; and they became rather widely known as mine. Yet it is clear that the only real merit in the discovery lay in my father's transformation of quaternions. In 1875, when I was in Germany, my father wrote to me that he was going to print a miscellaneous paper on multiple algebra and he wished to have it accompanied by a paper by me, giving an account of what I had found out. I wrote such a paper, and sent it to him; but somehow all but the first few pages of the manuscript were lost, a circumstance I never discovered till I saw the part that had reached him (and which he took for the whole) in print. I did not afterward publish the matter, because I did not attach much importance to it, and because I thought that too much had been made, already, of the very simple things I had done.

I here close the narrative. The priority of publication of the particular group referred to belongs to Professor Sylvester. But most readers will agree that he could not have desired to print it without making any allusion to my work, and that to say the group could be derived from my algebra was not too much.

C. S. PEIRCE.

A NOTE ON THE WORD "SOPHY" IN SHAKESPEARE'S TWELTH NIGHT.

Act II, sc. 5, 166: *Fabian.* I will not give my part of this sport for a pension of thousands to be paid from the *Sophy*.

Act III, sc. 4, 265: *Sir Toby.* They say he has been fencer to the *Sophy*.

These passages are well illustrated in a letter of a contemporary of Shakespeare, the Italian traveller, Pietro Della Valle.* The letter is dated Ispahan, March 17, 1617, less than a year after Shakespeare's death, and goes into much detail about the origin of the word "Sofi," which was a dynastic title, and hence disappeared with the extinction of the dynasty (vol. i, p. 464 of the Brighton ed. of 1843). Especially interesting is what Pietro has to say about Sir Robert Shirley, whose adventures in Persia had made the Sophy so familiar a name in England. The shah, he says, always wears a red cap, "like the other *quizilbasci*, or Turkoman soldiers," on certain solemnities. This is called *tag* or crown, and is the sign of belonging to the military and the nobility. This *tag* is sometimes conferred on foreigners who take service with the king, "just as an order of knighthood with us," but this happens seldom, and a well informed person told Pietro that he had seen it conferred only once in fifteen years. The bestowal of the *tag* is accompanied with great ceremonies, the king putting his own *tag* on the head of the person who is to receive the honor. And now we will let Pietro tell the Shirley story in his own sour-sweet way:

> "In questo modo fu dato il *tag* a quel don Roberto Serley inglese, che gli anni passati venne in Roma ambasciador di questo re a papa Paolo, e adesso torna un' altra volta a tutti i principi della cristianità; ed ho inteso qui che don Roberto lo domandò: ma io a dire il vero, non solo non domanderei giammai tal cosa al re di Persia, ma mi dispiacerebbe sopra modo quando egli me l'offerisse; perchè non so come un cristiano possa lecitamente portar quell' insegna, che, insieme con l'onorevole della militar nobiltà, ha congiunto anche in sè non poco del superstizioso della falsa loro setta; onde, per rimediare a ciò, conforme io penso, don Roberto intendo che in cristianità soleva portarvi in cima una croce. Ma oltre di questo, io non tengo che un Franco debba ambire di portare un' insegna d' onore, che è comune a molte migliaia di schiavi e di soldati ordinari; però per chi avesse voglia di vivere in Persia, come forse deve avere il detto don Roberto, potrebbe passar per cosa, se non desiderabile, almeno onorata."

Pietro was not averse to personal display and he might after all have consented to adorn his head as, at an earlier period of his travels, he had contrived to adorn his heels. Being in Constantinople he found that it was the fashion to have boot-heels shod with miniature horseshoes, and so he had his boot-heels shod, not with iron but with silver, a bit of dandyism, which, as he remarks complacently (vol. i, 97) was sufficiently conspicuous, and very cheap—(che per essa cosa insolita e neppur dall' istesso principe usata, con poca spesa in ciò lo feci parere una galanteria assai riguardevole).

B. L. G.

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*Pietro Della Valle, characterized by Gibbon (c. xxiv) as "an intelligent man, a gentleman and a scholar, but intolerably vain and prolix," was born in Rome, April 11, 1586, and died in the city of his birth, April 21, 1652. He was a great traveller, for his time, and out of the heap of garrulous detail much interesting matter might be sifted.

A letter has been received from Dr. C. S. Hastings, dated Callao, March 21, 1883. He had just arrived at Callao and expected to leave, March 22, on the U. S. steamer Hartford for the Caroline Islands, the point selected for the observation of the eclipse of May 6.

SIDNEY LANIER MEMORIAL FUND.

Mr. Lawrence Turnbull, treasurer of the committee of the Sidney Lanier Memorial Fund, makes the following report:

"The friends of the late Sidney Lanier collected the sum of $6,250, as a tribute of affection and honor, to be used for the benefit of his family. Of this amount, a concert in Baltimore yielded $543.85, and a reading by Mr. Victor Rigueur yielded $56.50. A concert in Augusta, Ga., yielded $231.00. A concert in Macon, Ga., yielded $208.25. The remainder was contributed by individuals in sums varying from $5 to $500.

Baltimore contributed in all, - - -	$4,555.35
New York " " - - -	75.00
Philadelphia " " - - -	545.00
Boston " " - - -	850.00

and there were scattering subscriptions from Newport, New Orleans, Charleston, North Carolina, and Texas.

The Committee in charge, after consultation, placed the fund in the hands of one of their number as trustee, to be put at interest and disbursed for the benefit of Mr. Lanier's family in annual instalments.

For the Committee,
BALTIMORE, *Jan.* 1, 1883. L. TURNBULL."

In this connection, it may be mentioned that by an additional contribution of some of the friends of Mr. Lanier, a memorial tablet has been placed in Hopkins Hall, bearing this inscription:

Aspiro dum Exspiro
SIDNEY LANIER
POET
Lectured here on Literature, 1879–1881.

COMMEMORATION DAY.

The twenty-second day of February, 1883, was observed according to usage as the Commemoration Day of the University. The public exercises of the day were held in Hopkins Hall at four o'clock in the afternoon. Brief address were made by President Gilman, and by Professor C. A. Young, of Princeton College. An announcement of the establishment by the Trustees of eighteen Honorary Hopkins Scholarships was made by the Hon. George William Brown, Chairman of the Executive Committee.

The degree of Doctor of Philosophy was conferred upon two candidates, viz:

Kakichi Mitsukuri, (Ph. B., Yale College, 1879), who here pursued studies in Biology and has since been called to the Professorship of Zoōlogy in the University of Tokio, Japan. His thesis on "The Structure and Significance of some Aberrant Forms of Lamellibranchiate Gills," has been published in the Monthly Journal of Microscopical Science.

Bernard F. O'Connor, (Bach. es Lettres, Université de France, 1874). His principal study was the Romance Languages, the subordinate, Latin. He submitted a thesis on "The Syntax of Ville-Hardouin."

The principal address by the Hon. S. Teackle Wallis was a discussion of the Johns Hopkins University in its relation to Baltimore. It has been printed in pamphlet form.

In the evening, there was a social assembly of the officers and students and their friends. The library and halls of the University were thrown open to a company of gentlemen and ladies, several hundred in number.

ENUMERATION OF CLASSES, SECOND HALF-YEAR, 1882-3.

Mathematics. (28 Students).

Classes meet in Room 16.

Theory of Partitions: PROFESSOR SYLVESTER. Twice weekly, Tuesday and Friday, 4 P. M. (10).

Barnes.
Bissing.
Collins, J. V.
Craig.
Davis.
Durfee.
Ely, G. S.
Franklin.
Hathaway.
Story.

Analytic Geometry: *Advanced Course:* DR. STORY. Twice weekly, Tuesday and Friday, 10 A. M. (4).

Bissing.
Craig.
Davis.
Hathaway.

Quaternions: DR. STORY. Three times weekly, Tuesday, Thursday, and Friday, 9 A. M. (4).

Barnes.
Collins, J. V.
Faerber.
Schuermann.

Conic Sections: DR. STORY. Three times weekly, Monday, Wednesday, and Thursday, 1 P. M. (9).

Artz.
Crum.
DeWitt.
Faerber.
Gilbert.
Howe.
Lyons.
Nixon.
Taber.

Partial Differential Equations: DR. CRAIG. Twice weekly, Monday and Thursday, 10 A. M. (2).

Collins, J. V.
Schuermann.

Elliptic and Theta Functions: DR. CRAIG. Three times weekly, Tuesday, Wednesday, and Friday, 11 A. M. (9).

Barnes.
Bissing.
Collins, J. V.
Davis.
Durfee.
Ely, G. S.
Hathaway.
Schuermann.
Story.

Hydrodynamics: DR. CRAIG. Three times weekly, Monday, Tuesday, and Thursday, 12 M. (5).

Barnes.
Brace.
Kimball.
Reid.
Schuermann.

Theory of Equations: DR. FRANKLIN. Three times weekly, Monday, Wednesday, and Friday, 11 A. M. (8).

Faerber.
Howe.
Nixon.

Total Differential Equations: DR. FRANKLIN. Three times weekly, Tuesday, Thursday, and Friday, 10 A. M. (9).

Duncan.
Faerber.
Howe.
Kimball.
Morrill.
Nixon.
Perkins, C. A.
Perkins, W. H.
Veblen.

Statics: DR. FRANKLIN. Three times weekly, Monday, Tuesday, and Thursday, 12 M. (5).

Crum.
Hathaway.
Howe.
Nixon.
Veblen.

Physics. (39 Students).

Classes meet in Rooms 3, 4, 7, 8.

Electricity and Magnetism: PROFESSOR ROWLAND. Four times weekly, Monday, Tuesday, Wednesday, and Friday, 8 P. M. (9).

Brace.
Duncan.
Goodnow.
Kimball.
Liebig, G. A.
Morrill.
Perkins, C. A.
Reid.
Schuermann.

Laboratory Work: PROFESSOR ROWLAND. Daily. (8 advanced students).

Brace.
Goodnow.
Kimball.
Koyl.
Liebig, G. A.
Morrill.
Perkins, C. A.
Reid.

Major Course: DR. HASTINGS. Lecture, weekly, Thursday, 8.30 P. M.; Laboratory work, daily, especially Wednesday. (14).

Brace.
Collins. J. V.
Davis.
Day, D. T.
Duncan.
Durfee.
Ely, G. S.
Hall, C. C.
Howe.
Kimball.
Morrill.
Reid.
Schubart.
Schuermann.

General Physics: *Minor Course:* DR. HASTINGS. Daily, 10 (21).

Artz.
Bayley.
Boston.
Campbell.
Carey.
Carroll.
Crum.
Dewitt.
Fels.
Gilbert.
Hillyer.
Hinkley.
Howard.
Huggins.
Johnston, R. C.
Lodge.
Orndorff.
Pleasant
Scott.
Williams,
Wilson.

During the absence of Dr. Hastings, this course has been conducted by Mr. J. Rendel H

Laboratory Work: (*Class in General Physics*)*:* DR. HAS and MR. REID. (17).

Artz.
Bayley.
Boston.
Campbell.
Carey.
Carroll.
Crum.
DeWitt.
Fels.
Gilbert.
Hillyer.
Hinkley.
Howard.
Johnston
Orndorff.
Pleasants
Scott.

Biology. (27 Students).

Classes meet in the Biological Laboratory.

Laboratory Work: PROFESSOR MARTIN and DR. SEDG Daily, 9 A. M. to 5 P. M. (25).

Beyer.
Cattell.
Colton.
Conn.
Councilman.
Donaldson. F.
Donaldson, H. H.
Duggan.
Ely, J. S.
Friedenwald.
Howell.
Jenkins.
Kemp.
Lee.
Lord, J. W.
Mackenzie.
Mills.
Mussey.
Nachtrieb.
Osborn.
Stevens.
Stratton.
Thomas,
Tuttle.
Wilson.

Animal Physiology: PROFESSOR MARTIN. Four times we Monday, Tuesday, Thursday, and Friday, 10 A. M. (18).

Beyer.
Cattell.
Conn.
Dewey.
Donaldson, H. H.
Ely, J. S.
Howell.
Jenkins.
Johnson, R. W.
Lee.
Mills.
Mussey.
Nachtrieb.
Osborn.
Stevens.
Stratton.
Thomas,
Tuttle.

General Biology: DR. SEDGWICK. Three times weekly, Mo Wednesday, and Friday, 11 A. M. (7).

Friedenwald.
Jenkins.
Kemp.
Lord, J. W.
Mussey.
Nachtrieb.
Wilson.

Osteology: DR. BROOKS. Twice weekly, Tuesday and Thursda A. M. (6).

Friedenwald.
Jenkins.
Lord, J. W.
Mussey.
Nachtrieb.
Wilson.

Mammalian Anatomy: DR. BROOKS. Twice weekly, Mo and Thursday, 12 M. (6).

Conn.
Jenkins.
Nachtrieb.
Osborn.
Stratton.
Thomas,

Chemistry. (43 Students).

Classes meet in the Chemical Laboratory.

Laboratory Work: PROFESSOR REMSEN, DR. MORSE, and COALE. Daily. (40).

Baker.
Bayley.
Boston.
Campbell.
Collins, A. T.
Councilman.
Cromwell.
Cumming.
Day, D. T.
Day, W. C.
Duggan.
Ely, J. S.
Friedenwald.
Gittings.
Gordon.
Hillyer.
Howell.
Huggins.
Johnston, R. C.
Keiser.
Kemp.
Laessig.
Liebig, R. A.
Lord, J. W.
Mills.
Mussey.
Orndorff.
Page.
Palmer.
Perkins, C. A.
Piggot.
Pund.
Schubart.
Smith.
Stokes, H.
Stratton.
Wiegand.
Wilkens.
Wilson.
Yonce.

Chemistry of Carbon Compounds: PROFESSOR REM Daily, 9 A. M. (16).

Applegarth.
Bayley.
Collins, A. T.
Duggan.
Ely, J. S.
Friedenwald.
Hillyer.
Howell.
Keiser.
Kemp.
Liebig, R. A.
Lord, J. W.
Orndorff.
Palmer.
Pund.
Wiegand.

General Chemistry: DR. MORSE. Daily, 9 A. M. (17).

Baker.
Boston.
Campbell.
Cromwell.
Cumming.
Duncan.
Gittings.
Huggins.
Johnston, R. C.
Laessig.
Mussey.
Page.
Perkins, C. A.
Schubart.
Smith.
Wilkens.
Wilson.

Mineralogy: DR. WILLIAMS. Twice weekly, Friday, 2–5 P. M., Saturday, 9 A. M. to 12 M. (13).

Bayley.
Collins, A. T.
Day, D. T.
Day, W. C.
Duggan.
Hillyer.
Keiser.
Liebig, R. A.
Orndorff.
Palmer.
Pund.
Robertson.
Wiegand.

Greek. (41 Students).

Classes meet in 181 Howard Street.

Seminary: PROFESSOR GILDERSLEEVE. Twice weekly, Monday and Wednesday, 12 M. (9).

Alexander.
Arnolt.
Emerson.
Fleming.
Harding.
Miller, C. W. E.
Murray, J. S.
Short.
Wiggins.

Pindar: PROFESSOR GILDERSLEEVE. Weekly, Thursday, 12 M. (9).

Alexander.
Arnolt.
Emerson.
Fleming.
Harding.
Miller, C. W. E.
Murray, J. S.
Short.
Wiggins.

Greek Syntax: PROFESSOR GILDERSLEEVE. Twice weekly, Tuesday and Friday, 10 A. M. (12).

Alexander.
Anderson.
Arnolt.
Cole.
Emerson.
Fleming.
Harding.
Holstad.
Miller, C. W. E.
Murray, J. S.
Wiggins.
Zweizig.

Comparative Grammar of Greek: DR. BLOOMFIELD. Weekly, Thursday, 4 P. M. (9).

Alexander.
Arnolt.
Bright.
Emerson.
Jagemann.
Short.
Spieker.
Tolman.
Warren, H. C.

Aeschylus: *Prometheus;* ***Euripides:*** *Medea:* PROFESSOR MORRIS. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 9 A. M. (9).

Cole.
Glenn, J.
Glenn, W. L.
Holstad.
Lodge.
McDaniel.
Murray, J. S.
Stout.
Walz.

Homer: *Iliad*, XVI–XIX: DR. SPIEKER. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 11 A. M. (14).

Bevan.
Buckler.
Crutchfield.
Cumming.
Egge.
Fink.
Gates.
Howard.
Loane.
McLane.
Merryman.
Rich.
Roberts.
Wilkens.

New Testament Greek: MR. HARRIS. Twice weekly, Monday and Wednesday, 1 P. M. (12).

Anderson.
Arnolt.
Beadenkopf.
Cole.
Cumming.
Gates.
Lodge.
McDaniel.
Rich.
Sieber.
Walz.
Webb.

Prose Composition:

Class A. PROFESSOR MORRIS. Weekly, Monday, 9 A. M. (6).

Glenn, J.
Glenn, W. L.
Lodge.
McDaniel.
Stout.
Walz.

Class B. DR. SPIEKER. Weekly, Monday, 11 A. M. (14).

Bevan.
Buckler.
Crutchfield.
Cumming.
Egge.
Fink.
Gates.
Howard.
Loane.
McLane.
Merryman.
Rich.
Roberts.
Wilkens.

Latin. (38 Students).

Classes meet in 181 Howard Street.

Seminary: Cicero: DR. WARREN. Twice weekly, Tuesday and Friday, 11 A. M. (10).

Fleming.
Harding.
Holstad.
Miller. C. W. E.
Murray, J. S,
O'Connor.
Pease.
Short.
Stout.
Zweizig.

Historical Latin Grammar: DR. WARREN. Weekly, Saturday, 9 A. M. (22).

Anderson.
Arnolt.
Canfield.
Egge.
Evenson.
Fels.
Fleming.
Glenn, J.
Glenn, W. L.
Harding.
Hinkley.
Holstad.
Lodge.
Lord, J. D.
Miller, C. W. E.
Murray, J. S.
O'Connor.
Pease.
Short.
Stout.
Walz.
Zweizig.

Plautus; Terence: DR. WARREN. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 12 M. (10).

Canfield.
Carey.
Glenn, J.
Glenn, W. L.
Hinkley.
Holstad.
Lodge.
Lord, J. D.
Stout.
Walz.

Latin Poets: *Crowell's Selections:* PROFESSOR MORRIS. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 10 A. M. (5).

Glenn, W. L.
Gregg.
Rich.
Stout.
Wilkens.

Horace: DR. SPIEKER. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 9 A. M. (11).

Bevan.
Buckler.
Crutchfield.
Fink.
Gates.
Loane.
Lyons.
McLane.
Pleasants.
Roberts.
Stokes, G. C.

Prose Composition:

Class A. DR. WARREN. Weekly, Monday, 11 A. M. (7).

Canfield.
Carey.
Glenn, W. L.
Hinkley.
Lodge.
Lord, J. D.
Walz.

Class B. PROFESSOR MORRIS. Weekly, Monday, 10 A. M. (5).

Glenn, J.
Gregg.
Rich.
Stout.
Wilkens.

Class C. DR. SPIEKER. Weekly, Monday, 9 A. M. (11).

Bevan.
Buckler.
Crutchfield.
Egge.
Fink.
Gates.
Loane.
Lyons.
McLane.
Pleasants.
Roberts.

Sanskrit. (5 Students). DR. BLOOMFIELD.

Classes meet in 181 Howard Street.

Rig-Veda: Twice weekly, Wednesday and Saturday, 10 A. M. (2).

Bright.
Warren, H. C.

Kathāsaritsūgara: Weekly, Wednesday, 8 P. M. (2).

Spieker.
Warren, H. C.

Comparative Grammar of Sanskrit: Weekly, Tuesday, 10 A. M. (3).

Bright.
Spieker.
Warren, H. C.

Elementary Sanskrit: Nala: Twice weekly, Tuesday and Friday, 4 P. M. (2).

Alexander.
Murray, J. S.

Hebrew. (4 Students). DR. BLOOMFIELD. Twice weekly, Monday, 4 P. M., Friday, 8 P. M., 181 Howard Street.

Beadenkopf.
Merryman.
Sieber.
Walz.

German. (43 Students).

Classes meet in 111 Monument Street.

(*Advanced Course*).

Gothic: DR. WOOD. Twice weekly, Monday, 11 A. M., Wednesday, 4 P. M. (4).

Arnolt.
Evenson.
Tolman.
Wright.

Old High German: DR. BRIGHT. Twice weekly, Tuesday and Friday, 4 P. M. (1).

Jagemann.

(*Major Course*).

German Literature: *Lectures in German:* Dr. Wood. Alternate Saturdays, 10 A. M. (9).

Dorsey.
Egge.
Evenson.
Glenn, J.
Kemp.
Johnston, R. C.
Ryttenberg.
Steiner.
Stratton.

Middle High German: Mr. Raddatz. Twice weekly, Tuesday and Friday, 8 P. M. (4).

Bissing.
Evenson.
Garthe.
Witzenbacher.

Stilübungen and Essays: Mr. Raddatz. Second Thursday of each month, 3 P. M. (9).

Bissing.
Dorsey.
Egge.
Evenson.
Glenn, J.
Johnston, R. C.
Ryttenberg.
Sieber.
Steiner.

Goethe: *Faust:* Dr. Bright. Twice weekly, Tuesday and Friday, 11 A. M. (9).

Anderson.
Dorsey.
Glenn, J.
Johnston, R. C.
Orndorff.
Ryttenberg.
Steiner.
Stratton.
Williams, H. W.

Lessing: *Hamburgische Dramaturgie:* Dr. Bright. Twice weekly, Monday and Thursday, 11 A. M. (11).

Anderson.
Dorsey.
Glenn, J.
Johnston, R. C.
Murray, J. S.
Orndorff.
Pease.
Ryttenberg.
Steiner.
Stratton.
Williams, H. W.

Prose Composition: Mr. Raddatz. Weekly, Wednesday, 8 P. M. (14).

Dorsey.
Egge.
Evenson.
Glenn, J.
Johnson, R. C.
Loane.
Orndorff.
Ryttenberg.
Scott.
Steiner.
Stratton.
Tiffany.
Williams, H. W.
Witzenbacher.

Syntax: Mr. Raddatz. Three times monthly, Thursdays, 8 P. M. (9).

Egge.
Glenn, J.
Orndorff.
Ryttenberg.
Scott.
Steiner.
Stratton.
Tiffany.
Williams, H. W.

(*Minor Course*).

Literary: *Goethe's Prose*; *Egmont:* Dr. Wood. Twice weekly, Tuesday and Friday, 12 M. (19).

Applegarth.
Artz.
Campbell.
Carroll.
De Witt.
Egge.
Gates.
Gilbert.
Harlan.
Loane.
Lord, J. W.
Miller, E. G.
Perkins, W. H.
Rich.
Roberts.
Scott.
Stokes, G. C.
Tolman.
Wright.

Historical: *Dahn's Urgeschichte der germ. und rom. Völker:* Dr. Wood. Twice weekly, Monday and Thursday, 12 M. (9).

Applegarth.
Caldwell.
Gates.
Loane.
Perkins, W. H.
Roberts.
Scaife.
Stokes, G. C.
Yager.

Scientific: *Humboldt in Auswahl:* Dr. Bright. Twice weekly, Monday and Thursday, 12 M. (7).

Boston.
Campbell.
Carroll.
De Witt.
Gilbert.
Lord, J. W.
Miller, E. G.

Prose Composition: Dr. Wood and Mr. Raddatz. Weekly, Wednesday, 12 M. (21).

Applegarth.
Artz.
Caldwell.
Campbell.
Carroll.
De Witt.
Egge.
Gates.
Gilbert.
Harlan.
Loane.
Lord, J. W.
Miller, E. G.
Perkins, W. H.
Rich.
Roberts.
Scaife.
Scott.
Stokes, G. C.
Tolman.
Wright.

Romance Languages. (21 Students).

Classes meet in 111 West Monument Street.

Advanced Courses; (5 classes). *Provençal* (*Extracts*); *Portuguese* (*Os Lusiadas*); *Old French* (*Vie de Saint Alexis*); *Franco-Norman* (*Roman de Rou*); *Provençal Dialects* (*Lectures*): Mr. Elliott. Monday, Tuesday, and Thursday, 12 M; Wednesday, 10 A. M. to 12 M. (8).

Bright.
Jagemann.
O'Connor.

(*Major Course*).

Spanish: *Don Quijote:* Mr. Elliott. Twice weekly, Monday and Thursday, 11 A. M. (4).

Harlan.
Perkins, W. H.
Wilson.
Witzenbacher.

Old French: Mr. Marcou. Twice weekly, Tuesday and Wednesday, 11 A. M. (2).

Harlan.
Perkins, W. H.

French Literature: Mr. Marcou. Weekly, Friday, 11 A. M. (3).

Harlan.
Perkins, W. H.
Witzenbacher.

French: Minor Course:

Historical: *Fustel de Coulanges:* Mr. Marcou. Twice weekly, Tuesday and Thursday, 1 P. M. (7).

Canfield.
Cromwell.
Kemp.
Lord, J. D.
Penniman.
Ryttenberg.
Wiegand.

Literary: *Victor Hugo:* Mr. Marcou. Twice weekly, Wednesday and Friday, 1 P. M. (6).

Canfield.
Cromwell.
Kemp.
Lord, J. D.
Penniman.
Ryttenberg.

Scientific: *Elisée Reclus:* Mr. Marcou. Twice weekly, Wednesday and Friday, 12 M. (1).

Wiegand.

Grammar and Composition: Mr. Marcou. Weekly, Monday, 1 P. M. (8).

Canfield.
Cromwell.
Kemp.
Lord, J. D.
Penniman.
Perkins, W. H.
Ryttenberg.
Wiegand.

Conversation Class: M. Rabillon. Appointments are made with individual students, daily, 12 M. (8).

Egge.
Evenson.
Howe.
Laessig.
Steiner.
Wilkens.
Witzenbacher.
Wright.

English. (36 Students).

Classes meet in 111 Monument Street.

Anglo-Saxon I: *Sweet's Reader, etc.*: Dr. Wood. Twice weekly, Tuesday and Friday, 4 P. M. (6).

Arnolt.
Crum.
Egge.
Evenson.
Tolman.
Wright.

Anglo-Saxon II: *Lectures, etc.:* Dr. Wood. Weekly, Thursday, 4 P. M. (7).

Cole.
Egge.
Miller, E. G.
Steiner.
Stratton.
Sudduth.
Wiegand.

Early English: *Morris's Specimens, etc.:* Dr. Wood. Twice weekly, Wednesday and Thursday, 11 A. M. (6).

Arnolt.
Egge.
Evenson.
Sudduth.
Tolman.
Wright.

Chaucer: Dr. Wood. Twice weekly, Monday, 4 P. M., Tuesday 8 P. M. (10).

Arnolt.
Egge.
Evenson.
Miller, E. G.
Steiner.
Stratton.
Sudduth.
Tolman.
Wiegand.
Wright.

Modern English: Dr. Browne. Twice weekly, Wednesday and Friday, 2 P. M. (29).

Anderson.
Artz.
Bayley.
Bemis.
Bevan.
Bissing.
Cromwell.
Crutchfield.
Cumming.
Egge.
Gates.
Glenn, W. L.
Howard.
Kemp.
Loane.
McCay.
McLane.
Miller, E. G.
Patten.
Pleasants.
Rich.
Sewall.
Stratton.
Shinn.
Sieber.
Steiner.
Thomas, H. M.
Wiegand.
Wilkens.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

February 7.—Forty-seventh regular meeting. Professor Sylvester in the chair. Thirty members present.

Papers read:

On the Action of Phosphorus on Moist Air, by I. Remsen. (*Abstract on p.* 74).

On Pleomorphism in Penicilium, by J. R. Duggan. (*Abstract on p.* 50).

A Note on the Helmholtz-Koenig Controversy, by G. Bissing. (*Abstract on p.* 74).

March 7.—Forty-eighth regular meeting. Professor Remsen in the chair. Forty-three members present.

Papers read:

On some Recent Investigations upon what is called the "Nascent" State of Elements, by I. Remsen.

On Progress in Spectrum Photography, by H. A. Rowland.

Note on the Anatomy of the Malar Bone, by E. M. Hartwell. (*Abstract on p.* 74).

Radial and Bilateral Symmetry in Animals, by H. W. Conn. (*Abstract on p.* 73).

April 4.—Forty-ninth regular meeting. Professor Martin in the chair. Forty members present.

Papers read:

On Alternation of Generations in the Hydro-Medusae, by W. K. Brooks. (*Abstract on p.* 73.

On Cilia in the Human Kidney, by A. H. Tuttle.

Dr. Story exhibited a number of models of surfaces of the second order, recently purchased by the University.

Philological Association.

February 2.—Forty-fourth regular meeting. Professor Gildersleeve in the chair. Twenty-nine members present.

Papers read:

On Participial Periphrases in Attic Prose, by W. J. Alexander. (*Abstract on p.* 66).

On the Second Mutation of Consonants in French, by H. C. G. Jagemann. (*Abstract on p.* 68).

On the General Theory of Greek Accentuation, by M. Bloomfield. (*Abstract on p.* 66).

On the Normal Forms of the Pliny and Cicero Letters, by J. R. Harris. (*Abstract on p.* 66).

March 2.—Forty-fifth regular meeting. Professor Gildersleeve in the chair. Twenty-six members present.

Papers read:

On the Athenian Jurisdiction over the Allies, by C. D. Morris. (*Abstract on p.* 69).

On French Syntax as Affected by the Cultivation of Style, by P. B. Marcou. (*Abstract on p.* 68).

On the so-called Dying Alexander of the Uffizi Gallery, by A. Emerson. (*Abstract on p.* 68).

April 6.—Forty-sixth regular meeting. Professor Gildersleeve in the chair. Twenty-four members present.

Papers read:

On Functional Differences of the Past Participle in the Periphrastic Perfects of the Latin, Old and Modern French, by A. M. Elliott.

On the Symmetrical Structure of the Pindaric Odes, by B. L. Gildersleeve.

Introductory Note on the Stichometry of Euthalius, by J. R. Harris.

On the Probable Sanskrit Equivalent of φίλος, by M. Bloomfield.

Historical and Political Science Association.

January 26.—Dr. H. B. Adams in the chair. Twenty-four persons present.

Papers read:

The English Parish in America, with illustrations from the original records of St. John's Parish, Harford and Baltimore Counties, Maryland, by H. B. Adams. (*Abstract on p.* 75).

Review of Lenormant's "Beginnings of History," by H. W. Caldwell. (*Printed in the American Literary Churchman, Baltimore, March*, 1883).

February 2.—Dr. H. B. Adams in the chair. Twenty-three persons present.

Papers read:

The Township in Maryland, by L. W. Wilhelm. (*Abstract on p.* 76).

Local Government in Montgomery County, with a Discussion of the School Question, by A. Bowie Davis, Esq. (*Abstract printed in The Sun, Baltimore, February* 3, 1883).

Critical Note on article "Henry Clay," in the Encyclopædia Britannica, by John C. Rose. (*Printed in The Nation, February* 15, 1883).

February 9.—Dr. R. T. Ely in the chair. Twenty-five persons present.

Papers read:

An Essay on the Financial History of the United States during the Civil War, by Arthur Yager.

The National Banking System of the United States, by L. W. Wilhelm.

February 16.—President Gilman in the chair. Forty-one persons present.

Remarks on the Relation of Physical Geography to the Study of History, by D. C. Gilman.

February 23.—Dr. H. B. Adams in the chair. Twenty-seven persons present.

Papers read:

The Baltimore and Ohio Employés Relief Association, by B. J. Ramage. (*Abstract on p.* 77).

Review of recent numbers of Sybel's Historische Zeitschrift, by J. F. Jameson.

Note on the Origin of the Monroe Doctrine, as explained in D. C. Gilman's "James Monroe," by H. B. Adams.

Remarks on the Monroe Doctrine and the Study of History and Politics, by President White of Cornell University.

March 2.—Dr. H. B. Adams in the chair. Thirty-four persons present.

Papers read:

Johann Most in Baltimore, by R. T. Ely. (*The substance of this paper will be incorporated in Dr. Ely's "Lectures on French and German Socialism," to be published by Harper & Brothers*).

The Influence of Schools and Industries upon the Development of Local Life at the South, by the Rev. A. D. Mayo, followed by a discussion of the Expediency of Popular Education, by Dr. G. Stanley Hall and others.

March 9.—Dr. H. B. Adams in the chair. Twenty-five persons present.

Papers read:

The Spanish Plots in the South-West, by C. H. Shinn. (*To be published in full in the Overland Monthly*).

Review of Conrad's Jahrbücher der National-oekonomie, by R. T. Ely.

March 16.—Dr. H. B. Adams in the chair. Twenty-six persons present.

Papers read:

Special Methods of Historical Study, as pursued at the Johns Hopkins University and Smith College, by H. B. Adams. (*To appear as a chapter in a forthcoming volume on Methods of Teaching History, edited by Dr. G. Stanley Hall*).

The Migration Problem, by C. H. Shinn.

March 30.—Dr. H. B. Adams in the chair. Twenty-one persons present.

Papers read:

Old Maryland Manors, by John Johnson. (*To appear in May as No. VII. of the University Studies in Historical and Political Science*).

Review of Doyle's "English Colonies in America," by H. B. Adams.

Mathematical Society.

February 21.—Dr. Story in the chair. Ten members present.

Papers read:

On the Non-Euclidean Theory of Conics, by W. E. Story. (*Abstract on p.* 71).

On the Tabulation of Symmetric Functions, by W. P. Durfee. (*Abstract on p.* 72).

On Partitions, by F. Franklin. (*Abstract on p.* 72).

March 21.—Professor Sylvester in the chair. Thirteen members present.

Papers read:

On the Divisions of Euler's Numbers, by G. S. Ely.

Note on the Strophoids, by E. Barnes.

Note on Conic Sections, by O. H. Mitchell.

On a General Theorem in Partitions, by J. J. Sylvester.

Metaphysical Club.

February 13.—Twenty-eighth regular meeting. Dr. G. Stanley Hall in the chair. Twenty-one members present.

Papers read:

A Study of Reaction, Time, and Attention in the Hypnotic State, by G. S. Hall. (*Published in "Mind," London, April*, 1883).

Mr. Joseph Cook and the Philosophy of Lotze, by J. M. Cattell.

A Review of Dr. Hopkins' "Outline Study of Man," by A. H. Tolman.

March 13.—Twenty-ninth regular meeting. Dr. G. Stanley Hall in the chair. Twenty-two members present.

Papers read

On the Development of Sight in the Lower Organisms, by H. N. Martin.

Concerning Perception and Reflex Action in the Frog, by W. T. Sedgwick.

April 10.—Thirtieth regular meeting. Dr. G. Stanley Hall in the chair. Eight members present.

Papers read:

Hegel and the Theory of Categories, by J. Dewey.

A note on Mechanical Logic, by J. Jastrow.

Naturalists' Field Club.

February 12.—Dr. W. T. Sedgwick in the chair.

Dr. B. W. Barton, of Baltimore, delivered a lecture upon "The Dispersion of Seeds and the Migration of Plants."

March 12.—Dr. W. T. Sedgwick in the chair.

Mr. H. H. Donaldson read a paper entitled "Notes on a trip to Labrador and New Foundland.

April 9.—Dr. Sedgwick delivered the last lecture of the course, on "The Migration of Birds."

Maryland Historical Society.

February 12.—Annual meeting and election of officers. Reports of officers submitted. The librarian read a list of the State Archives received on deposit from the State.

March 12.—The Publication Committee reported that they had invited Dr. William Hand Browne to the editorship of the State Archives, and that he had accepted the post; that a copyist was at work transcribing the earliest of the records, and that good progress was being made.

Paper: The Maryland Campaign of 1862 (Antietam), by C. F. Cobb, of Washington.

April 9.—Paper: The Public Life of John Jay, by William Whitelock.

The Johns Hopkins University Circulars are printed by Messrs. JOHN MURPHY & CO., 182 West Baltimore Street, Baltimore, from whom single copies may be obtained. They may also be procured, as soon as published, from Messrs. CUSHINGS & BAILEY, No. 262 West Baltimore Street, Baltimore.

[This Number is especially devoted to Statements of the College Courses. Information as to Graduate Instruction is given in other Circulars].

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JOHNS HOPKINS UNIVERSITY CIRCULARS

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THE COLLEGE COURSES OF THE JOHNS HOPKINS UNIVERSITY.

In the following pages, full information is given in respect to seven distinct collegiate courses which are offered to dergraduates in the Johns Hopkins University.

These courses are all based on the supposition that the student has passed an examination in the fundamental studies ually required for admission to American colleges, and has thus been matriculated. The tabular statement on page 97 hibits the distinctive features of each combination of studies, and detailed statements are given on subsequent pages.

In all these courses, various branches of literature and science are so combined as to secure a liberal education of e intellectual and moral powers, to store the mind with useful knowledge, and to cultivate the art of appropriate pression. The training here given is founded upon the ancient and modern languages, mathematics, the physical and tural sciences, history and the moral sciences. But to facilitate a wise selection among these branches seven definite urses have been arranged, some one of which the matriculated student is expected to follow. Students who prefer the ditional classical course have ample opportunities for the study of Greek and Latin, with classical antiquities, comrative philology, and other accessory subjects. Others who prefer to concentrate their main attention upon the higher and e more difficult branches of Mathematics, may do so. Other courses are arranged for those who wish to give their minds iefly to Chemistry and Physics, with particular reference to some of the new vocations of modern society. For those who pect at a later day to take up the study of Medicine, there is a special course marked out in which Biology or the study living things, animal and vegetable, in their forms and functions, is a dominant subject. Arrangements are also made other courses for the study of History and Political Science and of the Modern Languages and Literature.

Care is taken that, while certain important subjects preponderate in each course, there shall be subordinate and accessory quirements to prevent the student from having a narrow or one-sided development. Whatever course is followed, the wer to read French and German must be attained before the student graduates, and likewise the power to write good nglish. He must also work during one year in a scientific laboratory, and he must follow instruction in history, logic, hics, and psychology. In choosing his plan of study, every student will have the counsel of one of the Faculty as his adviser.

In exceptional cases, students not candidates for a degree are received as attendants upon special courses.

Those who have not had the opportunity to perfect themselves in all the branches requisite for matriculation, if nearly ady, are allowed to enter and finish their matriculation at the end of their first year's residence. The usual subdivision of asses is not maintained, so that students may prolong or shorten, within certain obvious limitations, the time of their underraduate courses; but rarely, if ever, will the course be completed in less than three years after full matriculation. Degrees are nferred at the end of the year, and at other times if there are special reasons therefor.

The next academic year begins September 18, 1883. Examinations for admission begin June 4 and September 18. here is a recess at Christmas and in the Spring.

At the close of each academic year, the University holds an examination of all classes on the studies of the year. Each structor is required to make (at least twice in the academic year) a written report of the standing of each member of his classes, sed both on observation of work done and on formal examinations.

The charge for tuition is eighty dollars per annum. There is an additional fee for material, etc., in the laboratories.

Hopkins Scholarships are open to candidates from Maryland (the District of Columbia), Virginia, and North Carolina. ee p. 102).

REQUIREMENTS FOR MATRICULATION.

All who wish to be candidates for the degree of Bachelor of Arts are expected, when they enter the University, to present themselves for the matriculation examination. A student who passes in a majority of the papers set for matriculation, but fails in some subjects, will be allowed to remain a member of the University, if the examiners report that his knowledge is such that he may reasonably be expected to complete his matriculation before the end of an academic year.

A student who has not completed his matriculation in the academic year following his admission, must make a fresh application for admission to the University, for the special consideration of the authorities. If again accepted, he will be allowed to count the matriculation subjects in which he has already passed, but until completing his matriculation he will not be permitted to attend any courses of class instruction in the University.

The requirements for matriculation are as follows:

Latin. Grammar, Prosody, and Composition; *Cæsar*, 5 books; *Ovid*, 2500 verses (500 elegiac); *Vergil*, *Æneid*, 6 books, and Eclogues; *Cicero*, 7 orations.

Greek. Grammar, Prosody, and Composition; *Xenophon*, Anabasis, 4 books; *Homer*, Iliad, 4 books; *Herodotus*, 1 book.

Note A. The accurate reading at sight of passages previously unseen may render unnecessary the examination in the books specified.

Note B. The subjects named, in both Mathematics and Languages, merely indicate the range of the examination. Equivalents are accepted.

Mathematics. *Arithmetic*, including the Metric system; *Algebra*, Todhunter, 38 chapters; *Geometry, Plane and Solid*, Chauvenet; *Plane Trigonometry*, Chauvenet, 8 chapters, or Wheeler; *Analytic Geometry*, Straight Line and Circle in rectangular coördinates, Salmon (Conic Sections) or Howison.

Note C. Only four-place logarithmic tables are provided or permitted to be used in the examination in Plane Trigonometry.

Note D. The examinations in Algebra and Geometry must be passed before the candidate will be examined in Trigonometry and Analytic Geometry.

Note E. A student may postpone for one year after entrance his examination in Trigonometry and Analytic Geometry, unless he is to take up at once Physics, (in which case he must show a sufficient knowledge of Trigonometry); or Mathematics, (in which case he must pass in all the required mathematical subjects).

French and German. Candidates who do not intend to pursue a classical course may offer French and German instead of Greek, and others may if they please offer French and German in addition to Greek.

There are two examinations in French and two in German for admission. The lower examination in each study is to ascertain whether the student has an elementary knowledge of the pronunciation, gender, inflections, etc.; the other examination is to see whether he can read at sight French or German prose.

Note F. To pass in French and German as substitutes for Greek, the student must be able to translate at sight one of these languages and to convert English prose into it; and to read at sight easy prose passages from the other.

Note G. The amount of German and French accepted, in any case, as a substitute for Greek at matriculation, does not count also among the courses to be registered as for graduation.

History. The outlines of the History of England and the United States.

Note H. Thompson's England and Doyle's United States are named to indicate the knowledge required.

English. Proficiency in English Grammar and Analysis, and a knowledge of the outlines of the History of the English Language are required.

Each student must further give evidence of ability to
English Language with correctness and propriety in writt
position.

Note I. Whitney's Essentials of English Grammar, and Lounsbury's Histo
English Language (Introduction and first eight chapters) are recommended
preparation.
Bad penmanship will be regarded as a serious defect.

Experimental or Observational Science. Each ca
must pass in one of the following subjects, and he will be ex
when he applies for admission, to signify in which of these
he proposes to take the examination—

a. The elements of *Physics*;
b. The elements of *Chemistry* (non-
metallic elements and their more
simple compounds);
c. *Physical Geography*;
d. The elements of *Botany*
ially plant analysis,
power of accurately de
a given plant;
e. The elements of *Physiol*

Entrance to Preliminary Medical Course.—Stude
wish to enter upon the biological courses preliminary to m
without reference to the degree of B. A., will be examine
trance in the following subjects:

Elementary Mathematics. Arithmetic; Algebra; thr
of Euclid, or an equivalent amount of Geometry; Plane Trigo
and the use of Logarithms.

The examination in Algebra will be confined to the following
tions and explanations of algebraical signs and terms; addit
traction, multiplication, and division of algebraical quantitie
proportion, and variation; simple equations involving not m
two unknown quantities.

Latin. Translation of passages from the first four books o
De Bello Gallico, and from the sixth book of the Æneid; the ele
Latin Grammar, especially Accidence.

Candidates who obtain permission at least a fortnight previo
be allowed to offer themselves for examination in equivalent po
other Latin classics.

English. Candidates will be examined in the whole of Lou
History of the English Language, and will be required to sa
examiner, by means of a written composition, of their ability to
themselves in correct and idiomatic English, properly spelled,
ated, and divided into paragraphs.

Physical Geography. Guyot's Physical Geography and
Physiography are recommended as text books.

French and German. In addition to the above subje
didates may offer themselves for examination in French and
those who pass will be excused from attendance upon the instru
these languages during the subsequent course of study.

The examination in French and German will test the ca
knowledge of the elements of the grammar of those languages
ability to translate at sight easy passages from prose authors.

Drawing. Some knowledge of Drawing is very desirable;
who are proficient in this subject may omit it from the subsequen

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Special Students.—In exceptional cases, young men
legiate age, who can satisfy a committee consisting of th
dent and two of the chief instructors that they are su
advanced in character and attainments to be allowed the p
and that there is some good reason why they should
themselves for matriculation, may be admitted to certain

TABULAR STATEMENT.

I. For Matriculation.

The matriculation examination includes Greek, Latin, Algebra, Geometry, Trigonometry, and Analytic Geometry,—with the History of England and the United States, English, and Elementary Science. French and German may be substituted for Greek by those who wish to follow scientific courses. See page 96.

II. Required Studies.

I.
ENGLISH COMPOSITION.
ENGLISH LITERATURE.

II.
GERMAN.
FRENCH.

III.
CHEMISTRY, or
PHYSICS, or
BIOLOGY.

IV.
LOGIC.
ETHICS.
PSYCHOLOGY.

V.
PHYSICAL GEOGRAPHY,
ANCIENT HISTORY,

VI.
DRAWING.
VOCAL CULTURE.
PHYSICAL CULTURE.
THEORY OF ACCOUNTS.

VII.
CERTAIN PRESCRIBED LECTURES
IN SCIENCE AND LITERATURE.

III. Elective Studies.

I.	II.	III.	IV.	V.	VI.	VII.
Latin. 1883-4. *(Daily, two years).* I. Livy. Horace. Prose Composition. Private Reading. II. (a) Lucretius. Plautus. Tacitus. Reading at Sight. Prose Composition. or (b) Cicero, Letters. Pliny, Letters. Aulus Gellius. Juvenal. Reading at Sight. Prose Composition. Private Reading.	**Mathematics.** *(Daily, two years).* I. Conic Sections. Differential and Integral Calculus. II. Theory of Equations. Solid Analytic Geometry. Total Differential Equations. Spherical Trigonometry.	**Chemistry.** *(Daily, two years).* I. Non-Metals. Metals. II. Chemical Philosophy. Analytical Chemistry. Chemistry of Carbon Compounds.	**Physics.** *(Daily, two years).* I. Elementary Mechanics. Sound. Light. Magnetism, and Electricity. Experimental Lectures. II. Application of Mathematics to Physical Problems. Quantitative Work in Laboratory. Lectures on Physical Astronomy. Reading — Maxwell, Helmholtz, Rayleigh, Thomson, etc.	**Latin.** *(Daily, two years).* I. Livy. Horace. Prose Composition. Private Reading. II. (a) Lucretius. Plautus. Tacitus. Reading at Sight. Prose Composition. or (b) Cicero. Pliny. Aulus Gellius. Juvenal. Reading at Sight. Prose Composition. Private Reading.	**History.** *(Daily, two years).* I. Livy. Tacitus. Thucydides. II. Early Church History. Mediæval Empire. Growth of Modern European States. Renaissance. Reformation. Revolutions.	**English.** *(Daily, two years).* I. Shakspeare, Chaucer, English Prose Writers. Grammatical and Rhetorical Exercises. Elements of English Phonetics and Language Building. History of the English Language. II. Anglo-Saxon. Early English. Exercises in Style, Essays, etc. Lectures on the History of English Literature.
Greek. 1883-4. *(Daily, two years).* I. Lysias. Homer. Euripides. Prose Composition. Private Reading. II. Thucydides. Aristophanes. Sophocles. Prose Composition. Private Reading. Comparative Philology and Classical Antiquities. Lectures.	**Physics.** *(Daily, two years).* I. Elementary Mechanics. Sound. Light. Magnetism and Electricity. Experimental Lectures. II. Application of Mathematics to Physical Problems. Quantitative Work in Laboratory. Lectures on Physical Astronomy. Private Reading—Maxwell, Helmholtz, etc.	**Biology.** *(Daily, two years).* I. General Biology. Human and Comparative Osteology. Elements of Comparative Anatomy. II. (a) Animal Physiology. Histology. Mammalian Anatomy. or (b) Animal Morphology. Comparative Embryology. Mammalian Anatomy. Marine Laboratory Work.	**Chemistry.** *(Daily, two years).* I. Non-Metals. Metals. II. Chemical Philosophy. Analytical Chemistry. Chemistry of Carbon Compounds.	**Mathematics.** *(Daily, two years).* I. Conic Sections. Differential and Integral Calculus. II. Theory of Equations. Solid Analytic Geometry. Higher Plane Curves. Spherical Trigonometry.	**Political Science.** *(Daily, two years).* I. Political Economy (Elements). History of Political Economy. II. Roman Law (Elements). American Constitution. English Constitution. Constitutions of European States. International Law.	**French.*** **German.** *(Daily, two years).* I. Historical Prose. Scientific Prose. German Classics. Exercises. II. Middle High German. German of XVI and XVII centuries. Deutsche Stilübungen Prose Composition. History of German Literature. Reading of German Classics.
Students who have completed the necessary work in German or French, may take up Mathematics or History.	Students who have completed the necessary work in German or French, may take up Latin, English, or History.	Students who have completed the necessary work in German or French, may take up Latin, Mathematics, or Italian.	Students who have completed the necessary work in German or French, may take up Latin, English, or History.	Students who have completed the necessary work in German or French, may take up English, History, or Greek.	Students who have completed the necessary work in German or French, may take up Mathematics, a Laboratory study, Spanish, or Italian.	Students who have completed the necessary work in French, or the first year in German may take up Mathematics, a Laboratory course, or History.

Each of the courses above named leads to the degree of Bachelor of Arts.

Hours.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	*Hours.*	*Hours.*
Latin, 9-10. Greek, 11-12. P. H. E., 12-1.	German, 11-12. P. H. E., 12-1. Mathematics, 1-2.	Physics, 10-11. German, 11-12. P. H. E., 12-1.	German, 11-12. P. H. E., 12-1. Mathematics, 1-2.	Latin, 9-10. German, 11-12. P. H. E., 12-1.	Classical History, 9-10. German, 11-12. P. H. E., 12-1.	Latin, 9-10. English, 11-12. P. H. E., 12-1.
Latin, 10-11. German, 11-12. Greek, 12-1.	Physics, 10-11. Mathematics, 11-12. French, 12-1.	Chemistry, 9-10. Biology, 11-12. French, 12-1.	Chemistry, 9-10. Physics, 10-11. French, 12-1.	Latin, 10-11. French, 12-1. Mathematics, 1-2.	History, 11-12. French, 12-1. Political Science, 1-2.	German, 11-12. French, 12-1. Physics. } Chemistry. }
Chemistry. } Physics. } Biology. } French, } Comp. Philology and Class. Antiquities, } 12-1 L. E. P., 1-2.	Chemistry, 9-10. Physics. L. E. P., 1-2.	Chemistry, 9-10. Biology. L. E. P., 1-2.	Chemistry, 9-10. Physics. L. E. P., 1-2.	Mathematics, 11-12. Physics or Chemistry, } L. E. P., 1-2.	Physics. } Chemistry. } Biology. } Political Science, 12-1. L. E. P., 1-2.	French. } 10-11. German. } English, 12-1. L. E. P., 1-2.

P. H. E. means the course in Physical Geography, History, and English Literature. L. E. P. means the course in Logic, Ethics, and Psychology. * See page 100.

The foregoing schedule is based on the principle that a "year" of study means five weekly exercises extending, with the examinations, through the entire academic year.

6. Juvenal, Select Satires.
   Three times weekly, second half-year. Dr. Warren.
   Reading at sight.
   Once weekly.
   Private Reading. (6*a*). Martial, Select Epigrams;
   Seneca de Tranquillitate Animi and Apocolocyntosis.
7. Prose Composition.
   Weekly exercises in connection with each of the above courses.

Greek.

1. Lysias, Select Orations.
   Four times weekly, first half-year. Dr. Spieker.
   Private Reading. (1*a*). Xenophon, Hellenica, i, ii.
2. Homer, Odyssey, ix–xii; Euripides, Alcestis.
   Four times weekly, second half year. Dr. Spieker.
   Private Reading. (2*a*). Herodotus, Merry's Selections.
3. Thucydides, vii.
   Four times weekly, first half-year. Professor Morris.
   Private Reading. (3*a*). Demosthenes in Timocratem.
4. Aristophanes, one play; Sophocles, Philoctetes.
   Four hours weekly, second half-year. Professor Morris.
   Private Reading. (4*a*). Euripides, Hippolytus;
   Aeschylus, Septem or Persae.
5. Prose Composition.
   Weekly exercises in connection with each of the above courses.

HISTORY AND POLITICAL SCIENCE.

The first year's work in History is directed to the study of the classic historians, Livy, Tacitus, and Thucydides. Courses in the Elements and the History of Political Economy must also be followed.

The field of historical study in the second year will be European History, with especial reference to Early Church History, Mediaeval Empires, the Growth of Modern States, the Renaissance and Reformation, and Modern Revolutions.

In Political Science, the Elements of Roman Law, the American Constitution, the Constitutions of England and the European States, and International Law will be taken up.

These studies will require not only the mastery of certain prescribed authors, or handbooks, but also an extensive course of outside reading, as may be recommended in individual cases, for the sake of forming habits of independent judgment and of acquiring, by the comparative method, an acquaintance with historical literature which will prove valuable in after-life. In connection with such reading, each student will be required to prepare, before graduation, at least five historical essays, satisfactory, in point of substance, to the instructor in History and, in point of style, to the instructor in English.

ENGLISH.

The work during the first year aims at making the student thoroughly and practically familiar with the resources of his native speech, both in language and literature.

The choice of older authors has been dictated by the necessity of following the historical method. Constant regard will be had, however, to living English speech, and to the best examples of it in modern authors. During the second year, the instruction will be mainly in the early periods of the language and literature. The object remains the same as during the first year, but an exact and fundamental knowledge of Anglo-Saxon and Old English will be imparted. Course *B* with its more general training may however be substituted in Anglo-Saxon for the more strictly language course *A*.

The following subjects are offered for the next academic year: —

I.

Shakspeare. Chaucer. Selections from English Prose writers.
Three times weekly.
Grammatical and Rhetorical Exercises.
Once weekly.
Elements of English Phonetics and Language Building.
Once weekly, first half-year.
History of the English Language.
Once weekly, second half-year.

II.

Either (*A*) Anglo-Saxon. *Twice weekly,*
or (*B*) Anglo-Saxon Law (Selected Texts), Antiquities, Religion, Customs, etc. *Twice weekly,*
and (with either *A* or *B*)
Old English.
Twice weekly.
Exercises in Style, Essays, etc.
Once weekly.
Lectures on the History of English Literature.
Once in two weeks.

GERMAN.

The first year aims to give a practical mastery of the language in reading and writing. The principles guiding the work of the second year have been stated in part, above, under English. During this year the study will be more distinctly historical, but, in certain cases, with the approval of the instructor, a more modern course may be selected (see below). Throughout the course constant attention will be paid to the synthetic character of German, as contrasted with the non-inflected, analytic English. An elementary knowledge is required for admission to the first year's course.

The following courses are offered for the next academic year: —

I.

1. Historical Prose.
   Dahn's *Urgeschichte der germanischen und romanischen Völker.*
   Twice weekly.
2. Scientific Prose.
   Hodges' *Scientific German* and Humboldt *in Auswahl.* *Twice weekly.*
3. Classics.
   Prose, one play; Minor Poetry. *Twice weekly.*
4. Exercises, with Whitney's Grammar.
   Weekly.

II.

5. Middle High German.
   Paul's and Weinhold's Grammars; Reading of Epic Poetry.
   Twice weekly.
6. German of the XVI and XVII centuries.
   Brant's *Narrenschiff*, Luther's "*An den Adel,*" Gryphius' *Peter Squentz.* *Twice weekly* (*one half-year*).
7. *a.* Deutsche Stilübungen.
   Monthly.
   b. Prose Composition.
   Whitney's and Paul's Grammars. *Weekly.*
8. History of German Literature.
   Lectures in German, with Kluge's *Deutsche Nationallitteratur.*
   Once in two weeks.
9. Reading of German Classics (1765–1832).
   Four times weekly.

NOTE.—Students have some choice, under the direction of the instructor, in making out courses. Thus a first year's course may be made up of 1, 3, 4; of 1, 2, 4; of 2, 3, 4. A second year's course might consist of 6, 7*b*, 8, with the whole of 9, first half-year, and two hours of 9, second half-year; of 5, 6, 7*a*, 8, and two hours of 9; of 6, 7*b*, 8, 2, and three hours of 9; of 6, 7*b*, 8, 1, and three hours of 9.

FRENCH.

The undergraduate work in French is carried forward upon the following schedule, during two years.

I.

Literary French.
Twice weekly.
Historical French.
Once weekly.
Scientific French.
Once weekly.
Exercises in Grammar and Composition.
Once weekly.

II.

Classical French, with Exercises in Style.
Once weekly.
Essay Writing in Modern French.
Once weekly.
Middle French (XVI century).
Twice weekly, first half-year.
Old French (XII and XIII centuries).
Twice weekly, second half-year.
Lectures on French Literature.
Once in two weeks.
General Principles of French Philology.
Once in two weeks.

TIMES OF EXAMINATION.

Young men who desire to enter the Johns Hopkins University for collegiate instruction, either as Matriculates, or as Students in branches preliminary to Medicine, or as Special Students in Mathematics, Chemistry, Languages, etc., are requested to present themselves with such introductions, written or personal, as they can command at the Registrar's office, on the morning of June 1 or 2, from 9 to 12 o'clock, when arrangements will be made for their examination, and information will be given in respect to classes, terms, lodgings, etc. Those who cannot appear in June may present themselves on Tuesday, September 18.

To persons at a distance, blank forms of application will be forwarded, upon the return of which, properly filled out, the candidates will be advised as to the expediency of their coming to Baltimore.

There are two formal examinations for matriculation, the first from June 4 to June 8, and the second from September 18 to September 22, as follows:

Monday, June 4.		*Tuesday, September 18.*	
Algebra,	9—12.	Algebra,	9—12.
Geometry,	3—6.	Geometry,	3—6.
Tuesday, June 5.		*Wednesday, September 19.*	
Trigonometry,	9—12.	Trigonometry,	9—12.
Analytic Geometry,	3—6.	Analytic Geometry	3—6.
Wednesday, June 6.		*Thursday, September 20.*	
Latin,	9—12.	Latin,	9—12.
Greek,	3—6.	Greek,	3—6.
Thursday, June 7.		*Friday, September 21.*	
German,	9—12.	German,	9—12.
French,	3—6.	French,	3—6.
Friday, June 8.		*Saturday, September 22.*	
English,	9—10.30.	English	9—10.30.
History,	11—12.30.	History,	11—12.30.
Natural Science,	3—4.30.	Natural Science,	3—4.30.

Candidates may offer some of the subjects at the June examinations, and the others in September.

Students resident in and near Baltimore are advised to present themselves at the examination in June, so that if deficient in any study they may prepare themselves in it for the examination in September. The results of the matriculation examinations will be made known June 9 and September 25.

CALENDAR.

The present term closes Friday, June 8, 1883.

The examinations for admission will be held June 4 to June 8, and September 18 to 22 as above stated.

The next term will begin Tuesday, September 18, 1883.

The first week is devoted to the examination of candidates for admission and matriculation, and to the organization of classes. It is expected that all the officers of instruction and government will be here during this period.

Instructions will be resumed Tuesday, September 25, 1883.

The term of instruction closes on Friday, June 7, 1884.

There will be a brief recess at the Christmas holidays and also in the early Spring.

Friday, February 22, 1884, will be observed as Commemoration Day.

HOPKINS SCHOLARSHIPS.

In accordance with the request of the founder of the University, twenty scholarships, called the "Hopkins Scholarships," freeing the holders from charges for tuition, were opened at the commencement of the University to young men who need this assistance. Probably an equal number will be annually bestowed.

The scholarships will be distributed among such candidates, "from the States of Maryland (including the District of Columbia), Virginia, and North Carolina, as may be most deserving of choice, because of their character and intellectual promise."

No publicity will be given to the names of those who are appointed or rejected, but a private announcement will be sent to each successful candidate.

These scholarships may be held for four years; but are liable to be forfeited because of deficiency in attainments, or of unworthy conduct.

The holders of these scholarships will not be exempt from the special charges made in the laboratories, etc.

Honorary Hopkins Scholarships.

In addition to the scholarships above named, eighteen Honorary Hopkins Scholarships have been instituted for the encouragement of conspicuous merit among undergraduate students who regularly matriculate.

Six of these scholarships will be annually offered to such candidates "from the States of Maryland, Virginia, and North Carolina as may be most deserving of choice because of their character and intellectual promise." Two scholarships will be offered annually to candidates from each of the States named.

The value of each scholarship will be $250 per annum and free tuition; and in case the holder of a scholarship withdraws from the University, for any reason, during the course of a session, such part of the allowance will be paid as seems equitable to the executive committee. The selection of candidates will be made by the Board of Advisers of Collegiate Students, at the beginning of each academic year, and publicly announced as honors. The same person may hold a scholarship for three years, if he continues to show himself worthy, but the question of his reappointment shall annually be decided by the appointing board.

Young men who desire to offer themselves as candidates for these scholarships should state this fact in writing when they appear for examination at the matriculation in June or in September. The papers of such candidates will then be carefully scrutinized by the examiners and the appointments announced.

CHARGES FOR TUITION, Etc.

The charge for tuition is eighty dollars per year, payable in two sums, forty dollars on the first of October for the first half-year, and forty dollars on the first of February for the second half-year. The Treasurer's office is not authorized to make a deduction for a period less than half a year, or to make a deduction because a student gives only a part of his time to study, or because he belongs to but one class. A deposit of ten dollars is required from each student. There is an additional fee for material, etc., in the laboratories.

Board and lodging in private houses near the University, may be obtained at five or six dollars, and upwards, per week.

ACADEMIC STAFF, 1882–83.

Daniel C. Gilman, LL. D., *President of the University.*

A. B., Yale College, 1852, and A. M., 1855; LL. D., Harvard University and St. John's College, 1876; Professor in Yale College, 1863-72; President of the University of California, 1872-75.

Basil L. Gildersleeve, Ph. D., LL. D., *Professor of Greek.*

A. B., Princeton College, 1849, and A. M., 1852; Ph. D., University of Göttingen, 1853; LL. D., College of William and Mary, 1869; Professor of Greek in the University of Virginia, 1856-76; Professor of Latin in the University of Virginia, 1861-66; *Editor of the American Journal of Philology.*

H. Newell Martin, Dr. Sc., A. M., *Professor of Biology, and Director of the Biological Laboratory.*

M. B., University of London, 1871, and Dr. Sc., 1872; A. B., University of Cambridge, 1874, and A. M., 1877; Fellow, and late Lecturer on Natural History in Christ College, Cambridge; Fellow of University College, London; M. D. (Hon.), University of Georgia, 1881; *Editor of Studies from the Biological Laboratory.*

Charles D. Morris, A. M., *Collegiate Professor of Latin and Greek.*

A. B., Lincoln College, Oxford, 1849, A. M., and Fellow of Oriel College, Oxford, 1852; Professor in the University of New York, 1875-76.

Ira Remsen, M. D., Ph. D., *Professor of Chemistry, and Director of the Chemical Laboratory.*

College of the City of New York; M. D., College of Physicians and Surgeons, N. Y., 1867; Ph. D., University of Göttingen, 1870; Professor of Chemistry in Williams College, 1872-76, and previously Assistant in Chemistry in the University of Tübingen; *Editor of the American Chemical Journal.*

Henry A. Rowland, Ph. D., *Professor of Physics, and Director of the Physical Laboratory.*

C. E., Rensselaer Polytechnic Institute, Troy, 1870; Assistant Professor in the same, 1872-75; Ph. D., Johns Hopkins University, 1880.

J. J. Sylvester, F. R. S., D. C. L., *Professor of Mathematics.*

A. M., University of Cambridge; F. R. S., London and Edinburgh; Corresponding Member, Institute of France; Member, Academy of Sciences in Berlin, Göttingen, Naples, Milan, St. Petersburg, etc.; LL. D., University of Dublin, University of Edinburgh; D. C. L., University of Oxford; Honorary Fellow of St. John's College, Cambridge; late Professor of Mathematics in the Royal Military Academy, Woolwich; Copley Medalist, Royal Society, London, 1880; *Editor of the American Journal of Mathematics.*

George W. Cable, *Lecturer for the current year on English Literature.*

Hiram Corson, A. M., LL. D., *Lecturer for the current year on English Literature.*

Professor of Anglo-Saxon and English Literature in the Cornell University.

F. Seymour Haden, F. R. C. S., *Lecturer for the current year on Etchers and Etching.*

Fellow of Royal College of Surgeons (England), 1857.

G. Stanley Hall, Ph. D., *Lecturer on Psychology*

A. B., Williams College, 1867, and A. M., 1870; Ph. D., Harvard University, 1878; Lecturer in Harvard and Williams Colleges.

J. Rendel Harris, A. M., *Lecturer on New Testament Greek.*

A. B., University of Cambridge, 1874, and A. M., 1877; Fellow, and late Lecturer and Librarian of Clare College, Cambridge.

James A. Harrison, A. M., *Lecturer for the current year on English Literature.*

Professor of Modern Languages, English, etc., in Washington and Lee University.

George S. Morris, A. M., Ph. D., *Lecturer on the History of Philosophy.*

A. B., Dartmouth College, 1861, and A. M., 1864; Ph. D., University of Michigan, 1881; Professor of Logic, Ethics, and the History of Philosophy in the University of Michigan.

Charles S. Peirce, A. M., S. B., *Lecturer on Logic.*

A. B., Harvard University, 1859, A. M., and S. B., 1863; of the U. S. Coast and Geodetic Survey.

Léonce Rabillon, Bach. ès Lett., *Lecturer on French Literature.*

Bach. ès Lettres, Université de France, 1832, and Licencié en Droit, 1836.

Herbert B. Adams, Ph. D., *Associate in History.*

A. B., Amherst College, 1872; Ph. D., University of Heidelberg, 1876; *Editor of University Studies in Historical and Political Science.*

Maurice Bloomfield, Ph. D., *Associate in Sanskrit.*

A. M., Furman University, 1877; Ph. D., Johns Hopkins University, 1879.

——————, *Associate in German.*

[On account of the resignation of Mr. Brandt, the duties of this chair have been temporarily by Dr. Wood and Professor Raddatz].

William K. Brooks, Ph. D., *Associate in Biology, and Director Chesapeake Zoölogical Laboratory.*

A. B., Williams College, 1870; Ph. D., Harvard University, 1875.

William Hand Browne, M. D., *Librarian, and Examiner in Engli*

M. D., University of Maryland, 1850.

Thomas Craig, Ph. D., *Associate in Applied Mathematics.*

C. E., Lafayette College, 1875; Ph. D., Johns Hopkins University, 1878.

A. Marshall Elliott, A. M., *Associate in Romance Languages.*

A. B., Haverford College, 1866, and A. M., 1878; A. B., Harvard University, 1868.

Richard T. Ely, Ph. D., *Associate in Political Economy.*

A. B., Columbia College, 1876, and A. M., 1879; Fellow of Columbia College, 1876-79; Ph. D., Un of Heidelberg, 1879.

Fabian Franklin, Ph. D., *Associate in Mathematics.*

Ph. B., Columbian University, 1869; Ph. D., Johns Hopkins University, 1880.

Charles S. Hastings, Ph. D., *Associate in Physics, Sub-Director Physical Laboratory, and Lecturer on Solar Physics.*

Ph. B., Yale College, 1870, and Ph. D., 1873; Holder of the "Tyndall Scholarship" in Paris,

Harmon N. Morse, Ph. D., *Associate in Chemistry, and Sub-Director Chemical Laboratory.*

A. B., Amherst College, 1873; Ph. D., University of Göttingen, 1875; Instructor in Chemistry herst College, 1875-76.

Charles F. Raddatz, *Examiner in German.*

Professor in the Baltimore City College.

William T. Sedgwick, Ph. D., *Associate in Biology.*

Ph. B., Yale College, 1877; Ph. D., Johns Hopkins University, 1881.

William E. Story, Ph. D., *Associate in Mathematics.*

A. B., Harvard University, 1871; Ph. D., University of Leipsic, 1875; Tutor of Mathematics vard University, 1875-76.

Philip R. Uhler, *Associate in Natural History.*

Librarian of the Peabody Institute, and President of the Maryland Academy of Sciences.

Minton Warren, Ph. D., *Associate in Latin.*

A. B., Tufts College, 1870; Ph. D., University of Strassburg, 1879.

Henry Wood, Ph. D., *Associate in English.*

A. B., Haverford College, 1869; Ph. D., University of Leipsic, 1879.

James W. Bright, Ph. D., *Assistant in German.*

A. B., Lafayette College, 1877, and A. M., 1880; Ph. D., Johns Hopkins University, 1882.

R. Dorsey Coale, Ph. D., *Assistant in Chemistry.*

Ph. D., Johns Hopkins University, 1881.

Edward M. Hartwell, M. D., Ph. D, *Instructor in Physical Culture.*

A. B., Amherst College, 1873, and A. M., 1876; Ph. D., Johns Hopkins University, 1881; M. D., Medical College, 1882.

Philippe B. Marcou, A. M., *Assistant in French.*

A. B., Harvard University, 1876, and A. M., 1879.

Hugh Newell, *Instructor in Drawing.*

Instructor in Drawing in the Maryland Institute.

Harry F. Reid, A. B., *Assistant in Physics.*

A. B., Johns Hopkins University, 1880.

Edward H. Spieker, Ph. D., *Assistant in Greek and Latin.*

A. B., Johns Hopkins University, 1879, and Ph. D., 1882.

Charles L. Woodworth, Jr., *Instructor in Elocution.*

Amherst College; Boston University School of Oratory, 1875.

ment to Johns Hopkins University Circular, No. 23.

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THE JOHNS HOPKINS UNIVERSITY IN ITS RELATIONS TO BALTIMORE.

.N ADDRESS DELIVERED AT THE SEVENTH ANNIVERSARY OF THE JOHNS HOPKINS UNIVERSITY,
FEBRUARY 22, 1883,

By Hon. SEVERN TEACKLE WALLIS, LL.D.
Of the Baltimore Bar.

'esident;
Gentlemen of the Board and of the Faculty:

M very sensible of the honor which has ɔeen done me by the invitation to take ɔart in your proceedings to-day, and yet accepted it with considerable hesitation. ›pics which are most appropriate to the n will not bear superficial treatment in presence, and it is not easy for a man intellectual habits and restricted pursuits › them any other. The problems of edu- and particularly of the higher education, :upying, at this moment, not only the best, e best-trained minds of the world, and ıtudy and solution have become a noble ty, into which the best intentions will not rash intrusion. One may be permitted to ıt what are irreverently called "crotchets" t altogether absent from even the higher .onal atmosphere, and there is, therefore, ›ater reason for dispensing with the crude ıtions of desultory thinkers.

ı not sure that it is not one of the most [results of the system which this univer- presents and embodies, to force upon men ere educated in our American colleges of century ago, a strong and perhaps not greeable sense of the comparative short- ;s of their own early intellectual training. , especially, of course, to those who passed ›nce and young, as was the custom then ıore than now—there being opportunity for :lse—from undergraduate life into profes- or other special and absorbing avocations. most of these I am persuaded that their ıte course was chiefly valuable, as a mem- discipline, and an influence; and that, from these, it contributed comparatively ɒ the permanent material out of which ntellectual life was constructed. Of my rofession, I think I can safely say, that the most of them were well content, if ɔuld keep alive the scholarly and classic which—whether the scholarship was much or little according to later tests—were bred and nurtured in their college days, and of which no one knows the solace and enjoyment half so well as they whose minds run in one life-long, narrow groove, yearning and longing, it may be, all the while, for something broader and better. Face to face with the precise and accurate teaching and knowledge of to-day, the systematized and ceaseless investigation, the critical ordeals, the perpetual search after truth and its fearless recognition when tested and established, the exact and scientific methods, the definite results, the scorn of routine and the rude questioning of tradition, which characterize the modern education—face to face, I say, with these, we remember our *curricula* and college examinations of the days gone by with feelings more or less grave, according to each man's sense of humor. It is not altogether human, of course, for the undergraduate of those times to forget, or even cease to love, the shade where he sported with his own academic Amaryllis—old though she be and faded now—but, clearly, to the dullest perception, a new order of things has arisen, and a better. Whether it be a development, or a new species, I remember nothing of my college learning which would enable me to determine.

There is one thing, however, which reconciles a man of the old dispensation to the risk of going beyond his depth on one of these occasions, and that is their total freedom from pretension. I have always greatly admired the quiet and unostentatious way in which the anniversaries of this university have been kept—instead of being what is commonly called "celebrated"—the notable contrast between the simplicity of the announcements and the large and progressive results which are announced. This seems to me not only the natural result of the plan and working of the university, and for that reason of great importance and significance, but very admirable in itself and as an example. Small things are so habitually called by large names among our people, and our little fishes—to use Goldsmith's criticism of

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Johnson—are so apt to speak like great whales, that the spectacle of an institution like this, discarding superlatives altogether, and telling its yearly story in a quiet way, without other emphasis than that inherent in the story told, is, to say the least of it, very edifying. One is almost able to flatter himself, sometimes, that the general tendency to public speaking, in this country, is something less than it once was, and that active elocution is not now quite so commonly regarded as the natural state of man. But, be this as it may, the "*tuba, mirum spargens sonum*," is beginning to go out of fashion as an accompaniment to what is worth telling, and we cannot but welcome, as a public service in that direction, every conspicuous demonstration that the soberer style is all-sufficient for the largest purposes of communication with the people.

I alluded, just now, to my own profession—that of the law—and I hope that I am not disloyal to it in expressing my gratification that the group with which it is generally associated, under the style of "the learned professions," has ceased, except in common and traditionary parlance, to monopolize that title. Of course, I should be very far from feeling gratification at their being less learned than heretofore—if such were the case. What I mean to speak of, as a ground for universal congratulation, is the fact that modern education has developed many other professions—all quite as worthy, to say the least, of being called "learned," and some of them involving the largest amplitude and variety of learning which the intellect can grasp. In speaking of these new professions, I deal with them, not merely as groups of students, devoted to research and discovery, and "hiving thought"—which is by far too much the common notion of them—but as bodies of eminently practical men, whose whole objects and methods are practical, in the truest meaning of the word, and whose business and purpose it is, not merely to find the ore of science, but to dig it, and bring it to the light, and make its products malleable, and adaptable to all the manifold uses of society. No one has illustrated in briefer phrase than Mr. Huxley the action and reaction of the practical and theoretical upon each other in science. I refer to his observation, that while "all true science begins with empiricism," it is true science, "exactly in so far as it strives to pass out of the empirical stage into the deduction of empirical from more general truths." With the spread and progress of these new professions, the old idea of the "practical man," the simple empiric—uneducated for the most part, except in so far as the manufacturer of pin's heads may be said to have a pin's head education—will pass into limbo. New avenues will be opened into the fields of industrial labor and production, and it goes without saying that the soil will respond to the tillage in which the head is guide of the hand. Doubtless the practical man will not yield without a struggle. When Sir Robert Peel proposed to establish the system of penny postage, a deputation of paper manufacturers waited upon him with a serious remonstrance, in which they urged that they would suffer incalculable loss, inasmuch as everybody would write upon note-paper instead of letter-sheets. But, precisely as the paper manufacturer has found that the increase of correspondence from cheap postage has developed tenfold his former trade, so the merely practical man will discover that the new education, which removes him from the place where he is dangerous or helpless except in his rut, will find him other occupations in which he can thrive, and will teach his children to tread the path, with knowledge, along which he groped in blind routine. It is most desirable, indeed, to have it understood that a multitude of new and truly practical avocations is the natural outcome of the new system and methods of scientific education. As I intimated just now, the average citizen has not altogether overcome the notion that a body of learned men, engaged in daily and laborious scientific research, is a sort of close corporation—very wise, very able, very eminent, no doubt, but set apart, by its nature and occupations, from the common uses and purposes of every-day life, and leaving its principal traces in the reports of "philosophical transactions." It is hard to make the ordinary thinker realize that the electric flame, which lights the whole coast-line of a continent with the radiance of a new sun, fresh taught to walk the night, was first kindled in a laboratory such as lies but a few paces from where you sit. You could ill persuade him to what an extent the biologist has unravelled the substantial problems of life in all nature, and has already instructed the physician to answer, through their solution, the hourly domestic questioning of disease and remedy. He would be astounded to know how physics and chemistry walk unseen and close by his side, lend-

him their help at every step of his existence,
at every stage and variety of the labor which
orts and the civilization which protects him.
ould not easily comprehend that the abstruse
ematics, whose written language may be to
an unknown tongue, is the great vehicle of
tific expression and fact from world's-end to
d's-end, almost bearing, Atlas-like, the globe
ience on its shoulders. He little imagines
the philologist whom he supposes to be en-
d in word-fancying and word-spelling — a
ss for which he has, himself, supreme con-
t — is shedding by his labors a new and cer-
light upon the history of mankind, is tracing
escent and relation of races and peoples, is
rating fable from truth, is putting tradition
story under cross-examination upon the wit-
stand, and fixing, even for religious inquiry
Biblical criticism, the certain and firm foun-
ns of faith and dissent.

repeat that these things, and others like
, are only half realized as living and prac-
truths by the average citizen who has work
and children to educate, and that the new
s of applied science, to which the teachings of
university open the way, are not yet known
recognized as they should, and as I am sure
will be, among us, when men are consider-
he future of those whom they love best and
to serve best. I should therefore feel, as
umble member of this community, that I
done as good a day's work for it as a man
well do for a community to which he owes
, if I could help to diffuse among its people
orough comprehension of what this noble
wment holds out to them with full hands.

in most American communities, it is our
to educate too little. Naturally, I do not
to those of our people to whom necessity
s no choice or discretion, but to those who
ble, and according to their lights are willing,
ucate their children. Their error lies in their
or imperfect notion of what an education
means. Instead of realizing that a young
is most likely to fall into the vocation
suits him best, and to make the most of
lf in it—after he has been taught enough
able him to measure his own gifts, and has
ufficient scope of instruction to fit him for
ne of various occupations, according to his
and opportunities—they choose or permit him to choose his calling beforehand, and endeavor to shape and mould what he learns to that and that only. Instead of his life-pursuit springing healthily and spontaneously like an indigenous plant, from those elements of a thoroughly cultivated mental soil which feed it best, his education is made a sort of hot-bed, to force the plant—perhaps against nature—in advance of its season, into the market. For the most part, if a professional career is to be adopted, they select the law or medicine. If warned, as they well may be, by the largely overcrowded ranks of both, they distrust the future of the young man in either, his course is shaped, in the main, for some mercantile pursuit, or for one of the many other occupations which are classed under the comprehensive head of "business." For these it is not supposed that any peculiar or protracted preparation is essential, the chief requisite being that the victim shall get through early and "go ahead." The idea that he will be the better fitted for every and any calling, and especially for moving from the rear to the front—from the ranks to command—according to the development of his faculties, the training and discipline of his mind, his knowledge of things knowable and his capacity to apply things applicable — does not seem to occur to the great mass of those to whom the destinies of young men are entrusted. Least of all, does it seem to enter their minds that there is a score of occupations, professional in the fullest and practical in the most literal sense, outside of those called "learned," in which a careful scientific education opens the door to the highest usefulness and success. I say nothing of the value of knowledge in itself and apart from the returns it brings. I speak here only of its value in use, of the resources and capital which it furnishes, and which neither the accidents of trade nor the vicissitudes of fortune can impair—much less destroy.

What has been said has been mainly in the interest of the student; but it is impossible to separate his interest, in these regards, from that of the community, or to overestimate the merely economical gain, to the whole country, of an infusion of scientific and educated labor and direction into all its industries and enterprise. It is painful to the last degree, in seasons of commercial disaster or depression, to see how absolutely without resource so large a number of our young men are, finding themselves deprived of their ordinary occupation, without knowledge enough of anything outside to enable them to turn in other directions for bread. They have pursuits, but really no calling. Nor is this true only of those who depend upon the vicissitudes of trade or speculation; for nothing is more certain in every industrial crisis than that the uneducated workman is the first to feel the loss of place or the pressure of reduced compensation. To those who may desire to make politics their profession—and even to the much larger number who merely seek political preferment—it is impossible to overestimate the value of those attainments, which enable a man to deal, in a capable and educated way, with the multifarious and complicated questions of scientific theory and fact, which spring up at every instant in the government of a mighty people like ours. Politics themselves are, of course, a science, and in the true sense one of the noblest of sciences. Practically, however, among us, they are rather what is called, in our old-fashioned law-English, an "art or mystery;" and they are learned and practiced as such, but not publicly taught, that I am aware. The Marquis de Costa Beauregard, writing to Joseph de Maistre in 1789, *à propos* of the impending revolution in France, made an observation which has always struck me as very clever, in the best style of French cleverness. "Dogmatic opinion," he said, "should not touch on politics, for on that head there is no revelation." I am afraid, from some personal experience, that the absence of revelation has not always prevented people from dogmatizing, somewhat actively, upon some political questions in this country; but I still am Utopian enough to believe that the time is not far off, when a chair of political science will be filled in every university, and men will be taught, in good faith, at all events, the radical distinction between politics and party, and between party and plunder. I am not very sanguine, however, I confess, as to the controlling effect of what men study at the university, in matters of government, upon their practical political courses; and I remember that I could not avoid some mental questionings upon that point, when listening with great interest, a few years ago, to a very able discourse, in which it was discussed, on one of the anniversaries of this university, by a distinguished gentleman of great authority, who is present here to-day. [President White, of Cornell University.] When entirely convinced, upon satisfactory and indifferent evidence, that a single representative in Congress, from a district which favors protection, has voted openly against a protective tariff, because he was taught free trade at college, I shall be willing to qualify my modest scepticism. Meantime, let us believe, at all events, with the great English teacher whom I have already quoted, that the time will come, "when there shall be no member of the legislature, who will not know as much of science as an elementary school boy."

These suggestions are presented in a loose and informal manner, for they belong too much to the commonplaces of the occasion to be offered in a more ambitious way. Indeed, it is because they are commonplaces, and yet are not understood and appreciated as they should be, that I have made them, from choice, the burden of what I have to say. If I could reach the ear of every man in this community, who has children whom he can afford to educate, I could not befriend him more, than by impressing him with a sense of the waste and folly of seeking for them, elsewhere, the instruction which is so prodigally at their service here. It is true that this is a university, and that it stands already, through its work and workers, in the front rank of universities. It is true that its great destiny, in the world of knowledge, is to be wrought out in its character of university. But it is a college as well. Its collegiate department is ample, its instruction thorough, its methods of the best. The teacher, instead of being, merely, as is so often the case—and as in the olden days he almost invariably was—a sort of circulating medium between the text-book and the undergraduate comprehension—is the companion and co-worker of his pupils. Surrounded in the study and the class-room, the laboratory and the lecture-room, with all the books and appliances which belong to the particular department; segregated, for the time, from all but the particular work and his companions in it; stimulated by competition, co-operation and encouragement; kept up to the mark by rigid, and yet wise and fair examinations; with nothing lacking to his development that educational science can supply, through the liberal application of a large and beneficent endowment—if the undergraduate student of this university cannot make a man of himself here, it will be in vain for him to go elsewhere for his making. It is easy, and often useful, to criticise the distribution of studies in every institution; and I believe there is no institution in which it is not habitually done, fairly or unfairly, as the case may be. But "dogmatic opinion" is as much out of place in such matters as in politics. It would be strange, indeed, if a new institution like this — scarce seven years old — were already so perfect in its entire organization as to be beyond criticism or improvement. It invites fair criticism — it hesitates at no change which brings improvement. For my own part, I cannot too heartily applaud the skill with which its undergraduate courses are distributed and the theory of their distribution — recognizing the eclectic principle, upon the one hand, by conceding the choice of studies, and yet preventing its abuse, by grouping the studies for selection. And then, above all, stands the university itself, beckoning the undergraduate on to its opportunities, advantages and honors. There he sees about him men of culture and enthusiasm, the graduates of other institutions, who have come to drink at the fountains which will flow for him also. All around him is labor, opportunity, life, progress and achievement. There is no such thing as standing still. The year-books of scientific research and discovery are filled with the results of what is going on around him. The men who lead and direct it, and they who come from a distance to help it on, are, many of them, world-famous — most of them becoming and worthy to become so. It seems to me that in all this there is everything to kindle the ambition and pride of the student, awaken his enthusiasm, and develop his powers. I can well understand that young gentlemen may sometimes prefer to have their powers developed, in their own way, at a distance from home and its restraints; and that what is called "college life" has attractions for some, which may outshine the allurements and opportunities of scholarship. But I cannot understand how it is that parents can take that view of the subject, or can believe that the shelter of the parental roof and the present watchfulness of parental solicitude and affection can diminish the value of the education which comes to their doors. Indeed, in the very many cases in which the question of education is, more or less, a question of cost to the parent, and he is forced or chooses to deal with it upon "commercial principles," it seems to me that he overlooks the first rule of "business," when he sends abroad for what he can procure, at least as good, on better terms, at home.

But, quite apart from these considerations, and worthy to be taken into account with the best of them, are the relation which this university bears, and is destined to bear, to our city and the State of Maryland, and the obligations which are incident to that relation. A man of large fortune, under the impulse of large and benevolent ideas, thought proper, at his death, to dedicate an ample portion of that fortune to the endowment of a great university among us bearing his name. It was the deliberate purpose of his life, and he selected, with deliberation and wise foresight, the agents and agencies for its consummation. To the best of their ability these trusted agents have done the work assigned to them, and no differences of opinion, upon other questions, can justify a doubt that they have done it, thus far, well. That this university, in its infancy, is already a noble monument to its Founder is, I repeat, a fact indisputable to all who are even superficially familiar with the records of scientific and educational opinion, at home and abroad. What it is, in itself and as a monument, it is to us and ours as it is to him. It should be our pride, as it is his glory. Day by day it is growing in every element of usefulness, and in every force that can work for good. All the seeds of development are germinating and quick within it. It is not here for to-day or to-morrow, for this year or the next, but for all time—a possession forever, so far as human things may be. Its Founder has done his part. His trusted agents have done theirs. It is for the people at whose feet the offering is laid to do their part likewise. Theirs must be a living and active part, too, or it will be vain and fruitless. Neither sympathy, nor sentiment, nor admiration, nor praise, will suffice. You had as well think of speeding a ship upon her voyage by wishing that the winds may blow—after the manner of the third ode of Horace. What the university needs, to make the most of itself—what the community needs, to make to itself anything of the university — is downright, actual, daily co-operation on the part of our people. They must realize to themselves what such an institution is worth, and can be made worth, to them and their posterity. They must think of it growing with their growth, exploring and developing their physical resources, enlarging their minds, expanding and refining their culture and their tastes, bringing home to them and naturalizing every new discovery and application of science elsewhere, and, domiciliating, as it were, among them, every fresh discovery and application of its own. They must appreciate its value, intellectually and socially, as a centre of thought—the resort of students and men of learning from a distance—all seeking its advantages and all bringing something in exchange for what they seek. Even to-day, there is hardly a field of current thought into which it has not already invited us to enter, under the guidance of men who are, themselves, among the leaders of thought in the world. And what are we to do with all this benefaction? Are we to stand and look at the university, afar off and from below, as men stand in a valley or a gorge and gaze at a castle on a hill? You will remember a score of Doré's pictures, which will tell you what I mean—the vivid light, above, on tower and keep, the darkness tangible beneath. Not so, I trust. I can imagine the stir, some morning, if the rumor were to run and to be true, that some galleon of the olden times—such as the English buccaneers (known historically, by the by, as the "great navigators") were in the habit of plundering on their way from Mexico to Spain—were anchored in our harbor, with her cargo of ingots of silver generously placed at the service of our citizens. I think one might venture to say that the significance of such a phenomenon would be promptly and generally comprehended in all its practical aspects—that the officers and even the crew of that welcome vessel would be borne in triumph to Druid Hill Park and Bayview, and all places of municipal attraction and delight, upon the footing of the most favored visitors, in the most gorgeous conveyances which could be provided by a liberal committee of our hospitable City Council. In regard to taking advantage of the godsend, I think probably the only question would be as to who should get the most of it. The cases of indifference or self-denial would hardly be numerous enough to be embarrassing. Yet many a galleon went to sea, in those old days, with less of actual counted [illegible] in her hold, than here, in money value, taken under the endowment of Johns Hopkins. Instead of tossing it into the air, in the shape of riches which make themselves wings and fly, he has planted it deep in our soil, so that it shall take root and grow. And can any one venture to compare the worth of his benefaction, if he had scattered it in present, actual largess to our people—so that some of it should go into every man's purse—with its value, as he chose to make it, to us and our posterity? Think of the actual, material money value—the material, tangible, yearly product—to a community, of successive and growing generations of educated men, carrying with them into every profession and every department of busy and social life, the knowledge which fertilizes every field, and fructifies every industry, and makes right hands of all the hands of enterprise. Counted by dollars and cents—tested by no book but the ledger—the actual wealth exceeds, a thousand-fold, to say the least of it, what would have come to us, if the money had been piled in one of our squares and been distributed to all comers, *per capita*, by the police. I put it in this purely economical and homely way, not to belittle the subject, nor by way of insinuating that our people are incapable of comprehending it in its proper statement and its loftier and nobler aspects. I only desire to illustrate what I mean, by showing, that if they were thoroughly and fully to realize the value of this foundation in all points of view, as they do realize, at sight, the value of present gold, or of the venture or the speculation to which they see, or think they see, a golden lining, there would be no need of urging their co-operation, to knit this university with their proudest hopes and most active struggles for the prosperous future of their city and their State.

A candid man must recognize, of course, that such co-operation, in a full and deep sense of its necessity and of the good that must come from it, cannot spring up, all at once, in a community whose citizens, for generations, have been accustomed to dispense too much with higher education and to look for what they have had of it to institutions at a distance. Habit and fashion are powerful and slow to change, in this as in things of lesser moment. A commercial city, which has been built up entirely by trade and its enterprises, cannot take in, upon short notice, all that is meant by its becoming, for the future, foundation like this will cry aloud in the wilderness and no man hearken to it. For the mere diffusion of knowledge among mankind—if that were all—it will matter little from what distance or from what quarter of the world the lamps are brought here to be filled and lighted. But, to us, it matters much whether or not we shall play the part of the foolish virgins. It was not merely for the general diffusion of knowledge that the university was endowed. Next the heart of its Founder was the prime and cherished desire, that the people among whom his wealth had been gathered, his friendships formed and the best years of his life usefully spent, should drink, first and chiefly, of the cup which he filled for posterity. It was not in his mind that they would turn from it or dash it from their lips. Nor, in what I have taken occasion here to say, nor from the earnestness with which it has been said, am I to be understood as anticipating or deeming it necessary to deprecate so pessimistic a result. Slowly, but with regular and certain progress, the interest of our people in this institution has been developing itself year after year. The increasing list of its undergraduate students discloses the significant and hopeful fact, that they are the sons of parents in all callings and all classes of life, and, in a large degree, of those who are most capable of passing an intelligent and, indeed, authoritative judgment upon the merit of educational systems and methods. That the influence of such approval and sympathy will diffuse itself, widely and certainly, in the course of time, it would be unreasonable to doubt. What I would impress upon our citizens — if my voice were worthy to be heard — is their waste of present time and opportunity in waiting; the loss, to the institution itself, of that immediate and happy impulse which would quicken it, if its halls were thronged with the ambitious youth and promise of Maryland, and the sympathy of her people were concentrated there, upon the labors and struggles and aspirations of their children. This is what I mean by the sympathy which I would venture to bespeak — the only sympathy which is practical and worth having. The longer it is delayed, the longer the usefulness of the institution will lack development for local good — the longer, of course, the postponement of that good, for those who will sit upon the banks and see tream go by.

In what has been said it has, of course, been understood that I have spoken as a citizen only, and in the interest of the community to which I belong. For the university, except in so far as it and the community are one in interest and in respect and duty to the Founder, I have no claim and could not presume to speak. But, having always taken the deepest interest in questions of public education, and having keenly felt, as well as constantly observed, in a long professional life, the need of more precise and accurate and full instruction, and especially scientific instruction, even among those whose educational opportunities have been best, I confess to a more than common solicitude for the speedy identification of this university with the intellectual development and progress of our people. Without undervaluing, for example, the facility with which an alert and well-trained intellect, in my profession, may for the moment appropriate to itself enough of special scientific knowledge for the occasional needs of the trial-table and the examination of experts, and may use that knowledge with efficiency and force, I cannot but recognize it as akin to the painful cramming by which young gentlemen sometimes substitute their memory for their intelligence, when examinations are hovering in the air. And it is a dreary thing, at the best, for a man to be prosecuting scientific inquiry in public, under the primary and difficult condition of not going beyond his own depth. I fancy that the embarrassment must be equally serious to the medical man and the Biblical student and teacher, when, to use a railway phrase, they are compelled to take in scientific fuel at all the way-stations. Perhaps, though I hardly venture to suggest it, they may share a certain relief, in the presence of their patients and hearers, which we have, in our way, at the bar. I mean the confidence that if counsel happen to know little of science, the jury probably know less. And here it is worth while to say — what I know to be true, from considerable opportunity of knowing — that the public would be startled, if they could realize the extent and depth of the ignorance of ordinary rudimental scientific principle and fact, upon the part of the great mass of those who are entrusted with the daily, practical application of the mightiest and most dangerous mechanical forces. I remember well the testimony of an engineman, who was produced as an expert in a case arising read it thus, beginning at the left: "*Hic jacit* (*jacet*) *Constantinus filius* * * * *" followed by other letters easy to make out on careful examination. It was simply the burial stone, he added, of some chieftain called Constantine, and bore his name and that of his father. It was to be lamented, said Mr. Wright, that Dr. Mill had thrown away so much learning so mistakenly.

I have ventured to give this remarkable statement in almost literal detail, because, apart from its point as an illustration, it seems to me almost as humorous in its way, and as delightfully circumstantial in its humor, as if Swift himself had invented it. In my limited reading, I do not remember to have met a thoroughly authentic report of any like occurrence in a learned society. Doubtless, many a Han Thanit may have been accredited to Tyre, and never found out to be a Roman; but, if the incident which I have described is at all characteristic of the proceedings of the British Association, there may well be said of it, what Lord John Townshend said of the House of Commons, when the celebrated grammarian, James Harris, the author of "Hermes," was taking the oaths of office. You will doubtless recall the story. "Who might that be?" said Lord John. Some one replied that it was Mr. Harris, "who had written on grammar and harmony." "Then, why the deuce," cried Lord John, "does he come to this place, where he will hear so little of either?"

From this illustration of what learning comes to, when it begins at the wrong end, we may well point the moral of what ignorance or half learning will end in, if it undertakes to be its own guide in research. The desire to know being the parent of all knowledge, men constantly persuade themselves that such desire and the willingness to work are all that is necessary for the attainment of their object. How many industrious and worthy lives are comparatively wasted under that mistake — in squaring the circle, or such like — it is difficult to estimate. Undoubtedly, the man who looks at the sun through a smoked glass, may have as ardent a desire to understand the phenomenon which his rude instrument discloses, as the astronomer who sails his thousands of miles, to plant his telescope on some wild mountain, or some lone island in mid-ocean. But not all the enthusiasm which ever lifted a man's face towards the heavens will teach him even "the sweet influences of the Pleiades," or make him know that "the bands of Orion" cannot be loosed. The Chaldæan system of instruction through the sheepfold has gone out of vogue, and the moon of our nights comes down to Endymion only through the lenses. The sum and substance of all science is fact; and the student, who does not know what research has already disclosed, cannot possibly know where the research of to-morrow should begin. His danger, if ill-directed or without direction, will always be, that he will soon forget the stake in the excitement or amusement of the game, and ultimately subordinate finding to seeking. It will be the familiar case of the collector, who begins with a taste or a love for pictures, or prints, or books, and ends with the uncontrollable and fruitless passion for collecting. To prevent the waste and abuse of intellect and effort, the abortive struggle, the disappointment and defeat, which come from imperfect teaching and the self-sufficient helplessness of undisciplined thought, is the high and special function of such educational authority as only a great university can wield. Wherefore, over and above the tending of its own fold, I find especial reason for rejoicing in the standards and methods which this university will establish and maintain among us, and in all our institutions of learning, by the authority of its example and position, and by the sheer and downright force of its intellectual preponderance. And when I speak of preponderance, it is of a superiority, not vaunted but frankly and generously recognized — an authority not less efficient, because founded on good feeling and respect, and exhibited in co-operation rather than control.

[*Addressing Judge Dobbin.*] — To you and me, Mr. President of the Board of Trustees, and to some of your co-workers, these things of even the near future, though visible enough and bright, have something of the light which comes to men, at evening, from beyond the sensible horizon where the earth-line fades. There is, perhaps, in this, some touch of sadness, but least of all, to one, like you, sir, who, having filled to the brim the measure of official usefulness and honor, can still give to this great work and to the service of the people who cherish you, the wisdom of age, the tempered zeal of robust and high convictions, and the vigor of faculties unimpaired.

PROGRAMMES FOR 1883-84.

The following courses in literature and science are offered for the academic year which begins September 18, 1883, and continues (with brief recesses at the holidays and in the spring) until June 7, 1884. They are open to all properly qualified young men according to conditions varying somewhat in each department and fully explained in other Circulars. Detailed statements as to the various subjects are given in the programmes of the departments of instruction on subsequent pages. A special Circular relating to College Courses has been issued.

The Annual Register giving detailed statements as to the regulations and work of the University will be sent on application.

B. L. GILDERSLEEVE, *Professor of Greek.*

(*a*) will direct the Greek Seminary. *Twice weekly through the year.*
(*b*) will conduct a course of Practical Exercises in Greek. *Twice weekly from October to January.*
(*c*) will interpret select tracts of Lucian. *Weekly after the first of January.*
(*d*) will give a course of lectures on the Syntax of the Greek Cases.

PAUL HAUPT, *Professor of the Shemitic Languages.*

will give the following courses:
(*a*) Hebrew for beginners. *Twice weekly through the year.*
(*b*) Arabic for beginners, or Ethiopic. *Twice weekly through the year.*
(*c*) Assyrian for beginners. *Twice weekly through the year.*
(*d*) Sumero-Akkadian. *Twice weekly through the year.*

H. N. MARTIN, *Professor of Biology.*

(*a*) will direct the Laboratory Work in Biology. *Daily through the year.*
(*b*) will lecture on Animal Physiology and Histology. *Three times weekly until February, and afterwards five times weekly till the close of the year.*

C. D. MORRIS, *Collegiate Professor of Greek and Latin.*

will form classes in:
(*a*) Thucydides (first half-year). Aristophanes; Sophocles (second half-year). *Four times weekly.*
(*b*) Lucretius; Plautus (first half-year). Tacitus (second half-year.) *Four times weekly.*
(*c*) Greek Prose Composition. *Weekly through the year.*
(*d*) Reading Latin at Sight. *Weekly through the year.*
(*e*) Latin Prose Composition. *Weekly through the year.*
(*f*) will read, with a class of undergraduates, the Homeric poems in Greek.

IRA REMSEN, *Professor of Chemistry.*

(*a*) will direct the Laboratory Work in Chemistry. *Daily through the year.*
(*b*) will direct the courses of lectures to advanced students.
(*c*) will lecture on General Chemistry (Non-Metals). *Four times weekly, first half-year.*
(*d*) will lecture on the Compounds of Carbon. *Four times weekly, second half-year.*
(*e*) will conduct a course on the Philosophy of Chemistry. *Weekly through the year.*

H. A. ROWLAND, *Professor of Physics.*

(*a*) will lecture on Thermodynamics, Heat Conduction, and Physical Optics. *Four times weekly through the year.*
(*b*) will direct a course of advanced work in the Physical Laboratory. *Daily through the year.*
(*c*) will conduct meetings for the discussion of current physical literature. *Weekly through the year.*

J. J. SYLVESTER, *Professor of Mathematics.*

(*a*) will lecture on Elliptic Functions. *Twice weekly through the year.*
(*b*) will lecture on Universal Multiple Algebra and Partitions. *Weekly through the year.*
(*c*) will direct the Mathematical Seminary, meeting *monthly through the year.*

H. B. ADAMS, *Associate Professor of History.*

(*a*) will direct the Seminary of Historical and Political Science. *Weekly through the year.*
(*b*) will give courses in the Sources of American Colonial History (first half-year), and in the Sources of American Constitutional History (second half-year). *Weekly.*
(*c*) will give twelve lectures on the Origin of Civilization, in the Introductory Historical Course.
(*d*) will lecture on Early Church History, Mediaeval Empire, the Italian Renaissance, and the German Reformation. *Twice weekly through the year.*
(*e*) will lecture in the first half-year on International Law, and, in the second half-year, on European and American Constitutions. *Three times weekly.*

M. BLOOMFIELD, *Associate Professor of Sanskrit.*

will give courses, during the first half-year, in:—
(*a*) Elementary Sanskrit. *Twice weekly.*
(*b*) Advanced Sanskrit. *Twice weekly.*
(*c*) Introduction into the Vedic Language. *Twice weekly.*
(*d*) Introduction into Pāli or Zend. *Weekly.*
(*e*) Introduction into the Elements of General Comparative Grammar.

W. K. BROOKS, *Associate Professor of Morphology.*

(*a*) will direct, during the summer months, the work of the Chesapeake Zoölogical Laboratory, located for the season of 1883 at Hampton, Va.
(*b*) will lecture on Animal Morphology or Comparative Anatomy. *Three times weekly, from December to May.*

HIRAM CORSON, *Lecturer on English Literature.*
will give a course of twenty public lectures on English Literature. *Three lectures weekly from January 21 to March 7.*

T. CRAIG, *Associate Professor of Applied Mathematics.*
will give courses in: —
(*a*) Spherical Harmonics, including Bessel's and Lamé's Functions. *Three times weekly, first half-year.*
(*b*) Calculus of Variations. *Twice weekly, first half-year.*
(*c*) Mathematical Theory of Sound. *Three times weekly, first half-year.*
(*d*) Partial Differential Equations. *Three times weekly, second half-year.*
(*e*) Curvature and Orthogonal Surfaces. *Twice weekly, second half-year.*
(*f*) Elasticity. *Three times weekly, second half-year.*

G. STANLEY HALL, *Lecturer on Psychology.*
(during the second half-year).
(*a*) will lecture on Physiological Psychology. *Twice weekly.*
(*b*) will lecture on Psychological Theories and Ethics. *Twice weekly.*
(*c*) will conduct a class in the Principles of Pedagogics. *Weekly.*
(*d*) will give five public lectures on educational topics in March–April, 1884.
(*e*) will direct the work of students engaged in special observation and research in the field of psychical phenomena. *Daily.*

J. RENDEL HARRIS, *Lecturer on New Testament Greek.*
will lecture twice weekly through the year on New Testament Greek. Special subjects — Textual Criticism; The Catholic Epistles; The Shepherd of Hermas.

C. S. HASTINGS, *Associate Professor of Physics.*
(*a*) will conduct the minor course in Physics, including experimental lectures, recitations, etc. *Daily through the year.*
(*b*) will give six lectures on the Theory of Errors.
(*c*) will give six or eight lectures on the Theory of Optical Instruments.
(*d*) will lecture on the application of Mathematics to selected problems in Physics. *Weekly.*
(*e*) will direct the work in the laboratory of the minor and major course students.

G. S. MORRIS, *Lecturer on the History of Philosophy.*
(during the first half-year).
(*a*) will lecture on the History of German Philosophy (Kant to Hegel). *Three times weekly.*
(*b*) will direct a Philosophical Seminary in the study of Spinoza's Ethics. *Twice weekly.*
(*c*) will conduct a course in Ethics for undergraduates.
(*d*) will give four public lectures on the Ethics of Social Relations.

H. N. MORSE, *Associate Professor of Chemistry.*
(*a*) will assist in directing the Laboratory work of the undergraduate students in Chemistry.
(*b*) will lecture on Analytical Chemistry. *Three times weekly. first half-year.*
(*c*) will lecture on General Chemistry (Metals). *Daily, second half-year.*

C. S. PEIRCE, *Lecturer on Logic.*
(*a*) will give forty lectures to graduate and special students on General Logic.
(*b*) will give special courses or private lessons upon any branch of Logic, in which graduate or special students may desire instruction.

L. RABILLON, *Lecturer on French Literature.*
will meet a class, weekly, for the purpose of reading and interpreting French classical writers, and will give special instruction in French conversation and composition.

W. E. STORY, *Associate Professor of Mathematics.*
will give courses in: —
(*a*) Advanced Analytic Geometry and Non-Euclidean Geometry. *Three times weekly through the year.*
(*b*) Mathematical Astronomy. *Three times weekly through the year.*
(*c*) Higher Plane Curves. *Twice weekly through the year.*
(*d*) Conics. *Twice weekly through the year.*

M. WARREN, *Associate Professor of Latin.*
(*a*) will direct the Latin Seminary. *Twice weekly through the year.*
(*b*) will give during the first half-year a course of lectures on Latin Palæography.
(*c*) will lecture during the second half-year on Latin Epigraphy and will conduct a series of weekly exercises in the interpretation of Latin Inscriptions.
will form classes for undergraduates in:
(*d*) Select Letters of Cicero and Pliny; Aulus Gellius. *Three times weekly, first half-year.*
(*e*) Juvenal, Select Satires; Horace, Select Satires. *Four times weekly, second half-year.*
(*f*) Latin Prose Composition. *Weekly through the year.*
(*g*) Reading Latin at sight. *Once in two weeks through the year.*

W. HAND BROWNE, *Examiner in English.*
(*a*) will receive and correct such essays as may be submitted to him by any member of the graduate or undergraduate courses.
(*b*) will read with a class of undergraduates selections from English literature with critical and historical comments. *Twice weekly through the year.*
(*c*) will read with a class Shakespeare's Hamlet, and Selections from English Prose since Bacon. *Twice weekly through the year.*

A. M. ELLIOTT, *Associate in the Romance Languages.*
(*a*) will give advanced courses in the Romance Languages (including Anglo-Norman French, Provençal, Romance Dialects, Comparative Grammar of the Romance Languages, Ladinian Idioms, and Wallachian). *Daily through the year.*
(*b*) will lecture on French Philology and French literature of the Middle Ages. *Forty lectures.*

R. T. ELY. *Associate in Political Economy.*
(*a*) will conduct the advanced course in Political Economy. *Three times weekly through the year.*
(*b*) will give ten lectures upon American Taxation, with especial reference to Cities and States.

(*c*) will give four lectures on English Socialism.

(*d*) will give courses in the Elements of Political Economy, and the Historical Systems of Political Economy. *Daily through the year.*

F. FRANKLIN, *Associate in Mathematics.*

will give courses in: —

(*a*) Differential and Integral Calculus. *Three times weekly through the year.*

(*b*) Total Differential Equations. *Twice weekly through the year.*

(*c*) Determinants and Theory of Equations. *Three times weekly, first half-year.*

(*d*) Solid Analytic Geometry. *Three times weekly, second half-year.*

(*e*) Dynamics of a Particle. *Twice weekly, second half-year.*

J. F. JAMESON, *Associate in History.*

(*a*) will give a series of lessons on Historical Geography, based on the study of the physical features of distinct regions.

(*b*) will teach French and English History. *Three times weekly through the year.*

(*c*) will teach a class in the History of the English Constitution. *Weekly through the year.*

(*d*) will teach a class in the History of Greece and Rome. *Twice weekly through the year.*

C. F. RADDATZ, *Examiner in German.*

W. T. SEDGWICK, *Associate in Biology.*

will conduct courses in:—

(*a*) General Biology. *Three times weekly, October to April.*

(*b*) Embryology of the Chick. *Four times weekly, April and May.*

(*c*) Plant Analysis. *Twice weekly, April and May.*

G. H. WILLIAMS, *Associate in Mineralogy.*

(*a*) will lecture on General Mineralogy. *Three times weekly, first half-year.*

(*b*) will lecture on General Geology. *Three times weekly. second half-year.*

(*c*) will direct the practical work in Mineralogy and Petrography.

H. WOOD, *Associate in English.*

(*a*) will conduct courses in Anglo-Saxon, Early English, and Chaucer. *Daily, through the year.*

(*b*) will conduct a series of Grammatical and Rhetorical Exercises in English. *Through the year.*

(*c*) will lecture on the elements of English Phonetics and Language Building. *Weekly, first half-year.*

R. D. COALE, *Assistant in Chemistry.*

will assist in directing the work of the beginners in the Chemical Laboratory.

H. W. CONN, *Assistant in Biology.*

will teach the classes in Osteology, Human and Comparative, and in Mammalian Anatomy.

H. H. DONALDSON, *Demonstrator of Physiology.*

will direct the practical work of the undergraduate classes in Physiology and Histology.

E. M. HARTWELL, *Instructor in Physical Culture.*

will direct the instruction in Physical Culture.

O. LUGGER, *Assistant in Biology.*

will have charge of the Museum of the Biological Laboratory.

H. NEWELL, *Instructor in Drawing.*

will give instruction in free hand and mechanical drawing, after 1 o'clock p. m., daily through the year.

E. H. SPIEKER, *Assistant in Greek and Latin.*

will teach undergraduate classes in Greek and Latin.

C. L. WOODWORTH, *Instructor in Elocution.*

will give instruction in Vocal Culture, daily through the year.

SPECIAL LECTURES ON EDUCATIONAL TOPICS.

PRELIMINARY ANNOUNCEMENT.

I. For Advanced and Graduate Students.—A course of lectures will be given to members of the University on topics relating to instruction in the higher institutions of learning. They will be informal lectures, connected only by the general purpose of helping advanced students who are looking forward, more or less definitely, to the work of teachers, to become familiar with the principles and methods followed by other persons, and with the results which have been obtained in different types of educational establishments.

1. The Present State of University and Collegiate Instruction in this country, by D. C. Gilman.
2. Recent Observations on Educational Foundations in Europe, by D. C. Gilman.
3. Natural and Ethnic History of Arithmetic, by J. J. Sylvester.
4. The Educational Value of Grammar, by B. L. Gildersleeve.
5. The Future Sphere of Classical Philology, by B. L. Gildersleeve.
6. Educational Value of the Study of Chemistry, by Ira Remsen.
7. What to Teach in Biology, by H. Newell Martin.
8. One Lecture by H. A. Rowland.
9. The Observational Element in Mathematics, by C. S. Peirce.
10. The *a priori* Element in Physics, by C. S. Peirce.
11. The *naïve* in Education, by H. Wood.
12. Modern Methods in the Study of History, by H. B. Adams.
13. Methods of Comparative Philology as pursued to-day, by M. Bloomfield.
14. The New Impetus given to the Study of Latin by the application of the Historical Method and by the study of Inscriptions, by Minton Warren.
15. Hygiene in Collegiate Training, by E. M. Hartwell.
16. Rhythm and Education, by G. Stanley Hall.
17. The Educational Value of Specialization and Original Work, by G. Stanley Hall.
18. On the Uses of Libraries in Education, by D. C. Gilman.

II. For Matriculated Students.—A course specially designed for college students will also be given.

1. On the Choice of a Profession, by D. C. Gilman.
2. On the Light which Biography throws on College Life, by D. C. Gilman.
3. On Reading as an Auxiliary to Study, by W. Hand Browne.
4. On the Right Use of Translations, by C. D. Morris.
5. On Historical Fiction, by H. B. Adams.
6. On the English Universities, by J. Rendel Harris.
7. On Recreation, by E. M. Hartwell.
8. On Mental Hygiene, by G. Stanley Hall.
9. On Science Work, by Ira Remsen.

MATHEMATICS.

PROGRAMME FOR 1883-4.

LECTURES, ETC.

FIRST HALF-YEAR.

PROFESSOR SYLVESTER:

Elliptic Functions.
Twice weekly.
Universal Multiple Algebra.
Once weekly.

DR. STORY:

Advanced Analytic Geometry.
Three times weekly.
Mathematical Astronomy.
Three times weekly.
Higher Plane Curves.
Twice weekly.
Conics.
Twice weekly.

DR. CRAIG:

Spherical Harmonics (including Bessel's and Lamé's Functions).
Three times weekly.
Calculus of Variations.
Twice weekly.
Mathematical Theory of Sound.
Three times weekly.

DR. FRANKLIN:

Differential and Integral Calculus.
Three times weekly.
Determinants and Theory of Equations.
Three times weekly.
Total Differential Equations.
Twice weekly.

SECOND HALF-YEAR.

PROFESSOR SYLVESTER:

Elliptic Functions (*continued*).
Twice weekly.
Universal Multiple Algebra (*continued*) and Partitions.
Once weekly.

DR. STORY:

Advanced Analytic Geometry (*continued*) and Non-Euclidean Geometry.
Three times weekly.
Mathematical Astronomy (*continued*).
Three times weekly.
Higher Plane Curves (*continued*).
Twice weekly.
Conics (*continued*).
Twice weekly.

DR. CRAIG:

Partial Differential Equations.
Three times weekly.
Curvature and Orthogonal Surfaces.
Twice weekly.
Elasticity.
Three times weekly.

DR. FRANKLIN:

Differential and Integral Calculus (*continued*).
Three times weekly.
Total Differential Equations (*continued*).
Twice weekly.
Solid Analytic Geometry.
Three times weekly.
Dynamics of a Particle.
Twice weekly.

Undergraduate Courses.

NOTE.—In the first year of the undergraduate courses, the student will take up Conic Sections and the Calculus. In the second year, Theory of Equations, Solid Analytic Geometry, Spherical Trigonometry, and either Total Differential Equations or Higher Plane Curves. Those who elect Physics as a principal subject of study will take up Differential Equations.

Mathematical Society.

The Mathematical Society, composed of the instructors and more advanced students, will meet monthly as heretofore, under the presidency of Professor Sylvester, for the presentation and discussion of papers or oral communications.

WORK OF THE PAST YEAR, 1882-3.

COURSES GIVEN.

Professor Sylvester:

Theory of Substitutions. *Twice weekly, first half-year.*
Theory of Partitions and of Mean Values. *Twice weekly, second half-year.*

Dr. Story:

Analytic Geometry (Advanced Course). *Three times weekly, first half-year; twice weekly, second half-year.*
Higher Plane Curves. *Three times weekly, first half-year.*
Conic Sections. *Three times weekly, second half-year.*
Quaternions. *Three times weekly, second half-year.*

Dr. Craig:

Elliptic Functions. *Three times weekly, first half-year.*
Definite Integrals. *Twice weekly, first half-year.*
Mechanics. *Three times weekly, first half-year.*
Calculus of Variations. *Twice weekly, first half-year.*
Partial Differential Equations. *Twice weekly, second half-year.*
Elliptic and Theta Functions. *Three times weekly, second half-year.*
Hydrodynamics. *Three times weekly, second half-year.*

Dr. Franklin:

Determinants. *Daily, during October.*
Differential and Integral Calculus. *Daily, first half-year.*
Solid Analytic Geometry. *Three times weekly, first half-year.*
Theory of Equations. *Three times weekly, second half-year.*
Total Differential Equations. *Three times weekly, second half-year.*
Statics. *Three times weekly, second half-year.*

List of Papers Read at the Mathematical Society.

E. BARNES.—Note on the strophoids.

E. W. DAVIS.—On the maximum value of a certain determinant; note on binodal quartics.

W. P. DURFEE.—On the tabulation of symmetric functions.

G. S. ELY.—On a geometric locus; on the numbers $a_{m,n}$ which occur in connection with the proof of Staudt's theorem concerning Bernouilli's numbers; on the divisions of Euler's numbers.

F. FRANKLIN.—On Crocchi's theorem; on the expression for the volume of a tetrahedron in terms of its edges; on partitions; on the value of Euler's constant.

A. S. HATHAWAY.—On the equation of a curve referred to a maximum inscribed triangle; a proof of a theorem of Jacobi, by correspondence.

O. H. MITCHELL.—Note on conic sections.

C. S. PEIRCE.—On a class of multiple algebras.

W. E. STORY.—On measurement in non-Euclidean geometry; on the non-Euclidean theory of conics; a remark on Farey series; on the number of intersections of curves drawn on quadrics; on the number of intersections of curves drawn on a given ruled surface.

J. J. SYLVESTER.—On certain successions of integers that cannot be indefinitely continued; on Crocchi's theorem; on a fundamental theorem in the new method of partitions; proof of a well-known development of a continued product in a series; on the number of fractions in their lowest terms whose numerators and denominators are limited not to exceed a certain number; on a general theorem in partitions; on a theorem in the *Fundamenta Nova;* on Farey series.

Three numbers of the fifth volume of the AMERICAN JOURNAL OF MATHEMATICS have been issued during the academic year, and the concluding number of the volume is in press and will shortly appear.

PHYSICS.

PROGRAMME FOR 1883-84.

I. Minor Course.

This course, which will be conducted by **Dr. Hastings**, embraces experimental lectures, recitations, and examinations, five times a week throughout the year, with one half-day each week given to laboratory work. The subjects taken up will include Mechanics, Acoustics, Optics, Light, Heat, Electricity, and Magnetism.

This course precedes the study of Chemistry and Biology as taken by the students in the course Preliminary to Medicine. A knowledge of Plane Trigonometry is essential for admission to the course.

II. Advanced Courses.

Professor Rowland:

1. Thermodynamics, Heat Conduction, Physical Optics.
   Four lectures weekly.
2. Meetings for the Discussion of Current Literature.
   Weekly.

Dr. Hastings:

3. Theory of Errors.
   Six lectures.
4. Application of Mathematics to Selected Problems in Physics.
   Lectures weekly.
5. Theory of Optical Instruments.
   Six or eight lectures. (This course, announced for the last year, was omitted by reason of Dr. Hastings's absence.)
6. Courses of Selected Readings in Physics by the students, with examinations.

Heretofore these have embraced selections from the following works, one from each group being requisite:

Sound: Helmholtz.
Heat: Maxwell, Wüllner, Verdet, Tyndall.
Electricity and Magnetism: Jenkin, Wüllner, Verdet.
Light: Wüllner, Lloyd, Daguin, Jamin, Verdet.
Conservation of Energy: Youmans, and others.

Dr. Craig:

7. Mathematical Theory of Sound.
   Three times weekly, first half-year.
8. Spherical Harmonics.
   Three times weekly, first half-year.
9. Partial Differential Equations.
   Three times weekly, second half-year.

III. Laboratory Work.

The Physical Laboratory is furnished with apparatus purchased from the best European and American makers, selected with special reference to investigations, and especially valuable for researches in electricity, magnetism, light, and heat. The laboratory will be open for work, under the direction of Professor Rowland and Dr. Hastings, daily through the year.

Experiments will be made during the coming year with a view to aid in establishing an international unit of electrical resistance. The experiments will be carried on, under the direction of Professor Rowland, with an appropriation from the government of the United States. The results will be communicated to the International Commission of Electricians, meeting in Paris.

Note.—Candidates for the degree of Ph.D., who take Physics as a principal subject will be expected to attend Professor Rowland's lectures for at least two years; to work not less than two years in the laboratory or to show such attainments in the mathematical theories of Physics as may be regarded as an equivalent; to exhibit a familiarity with a selected group of subjects, such as are treated by the following authors:

History: Poggendorff, Grant (History of Physical Astronomy);
Mechanics: Kirchhoff, Thomson & Tait, Poisson, Duhamel, Jacobi, Peirce, Resal, Routh, Newton, and (on special topics) Riemann, Beer, and Lamé;
Sound: Rayleigh, Helmholtz;
Optics: Fresnel (special memoirs), Billet, Verdet, Gauss (Dioptrische Untersuchungen), Young, Helmholtz (Physiologische Optik);
Heat: Clausius, Rankine, Verdet, Rühlmann, Briot, Fourier;
Electricity and Magnetism: Maxwell (complete treatise), Faraday, Wiedemann, Mascart, De la Rive, Thomson (papers on Electricity and Magnetism).

Such candidates will also be required to present a thesis upon some subject in that branch of Physics upon which they have been especially engaged.

[Further notices on this subject are postponed until the return of Dr. Hastings].

WORK OF THE PAST YEAR, 1882-83.

The rooms devoted to the Physical Laboratory have been open daily for the prosecution of advanced study and research, under the direction of Professor Rowland and Dr. Hastings.

During the year original investigations in the following subjects, among others, have been carried on:

On the photography of the spectrum by means of the concave grating.

[The photographs of the spectrum so far made extend down to B, the original negatives being about ⅔ the scale of Angström's map from *B* to b. equal to Angström's from b to G and 1½ Angström's from G to the extreme ultra violet. They show 150 lines between the H lines and give the 1474 and b_3 and b_4 widely double, and the E line indistinctly double].

On the determination of the B. A. unit of electrical resistance in absolute measure.

On the determination of the specific resistance of mercury.

On the variation of the specific heat of water with the temperature.

On the relative wave lengths of the lines of the spectrum by means of the concave grating.

On the effect of difference of phase in the harmonics on the timbre of the sound.

On the variation of the magnetic permeability of nickel by change of temperature.

V. Mineralogy and Geology.

Dr. George H. Williams will give during the first half-year a course in *General Mineralogy*, consisting of three lectures weekly, supplemented on Saturdays, from 9 a. m. until 12 m., by practical exercise in the subjects treated of in the lectures of each week.

During the second half-year, Dr. Williams will give a course of three lectures weekly in *General Geology*, with especial reference to Petrography and the modern methods of the study of rocks.

There will be an opportunity offered to those who may desire to do practical work in mineralogy and microscopical petrography.

WORK OF THE PAST YEAR, 1882-83.

During the past year the Chemical Laboratory has been much enlarged and improved, and fully equipped for all kinds of chemical work. It now covers an area of about 50 by 100 feet and has three full stories and a basement. In the basement are the necessary conveniences for assaying and other furnace operations. On the next floor there are large rooms devoted mainly to qualitative and quantitative analysis. On the second floor, are the rooms for research work, those of the director, the library, and a lecture-room for General Chemistry. On the third floor, are rooms for the chemical and mineralogical collections, a working and lecture-room for mineralogy and a second lecture-room for chemistry. The laboratory will conveniently accommodate about ninety working students.

Advanced students have been engaged daily in the laboratory in prosecuting such work as seemed best adapted to the purposes of each. Those who have completed the full courses in General Chemistry, including from two to three years' work in qualitative and quantitative analysis and about a year's work in making difficult and instructive preparations, were encouraged to undertake the solution of original problems.

The following investigations have been completed during the year. Others are in progress.

On the conduct of moist phosphorus and air towards carbon monoxide.

White phosphorus.

Oxidation of a compound containing the sulphamine and propyl groups in the ortho position with reference to each other, showing protection of the propyl.

Oxidation of paradipropylbenzene-sulphamide, showing protection of the propyl.

On the nature of sinapic acid.

The influence of light on fermentation.

Chemical examination of minerals from the neighborhood of Jones's Falls.

The results of these investigations have either already been or will soon be published in the *American Chemical Journal.* Some have also been brought before the Johns Hopkins Scientific Association at its regular meetings.

Advanced students have also taken part in meetings held twice weekly through the year for the purpose of reporting on the current journals of chemistry. All the important journals were carefully read, and the articles then fully reported on. Not only the teaching staff, but the fellows and other advanced students, worked in this direction throughout the year.

Advanced workers have been frequently called upon to work up broad subjects from the sources. In most cases the subjects have been those connected with the experimental work carried on in the laboratory; but others not directly connected with work in the laboratory have also been taken up in this way. Carefully written reports of the results obtained have been prepared in several cases. This very desirable literary work is much facilitated by the fact that an excellent library of chemical journals and other works is in the laboratory, and accessible during the working hours to all students.

At the beginning of the year subjects for advanced historical lectures were assigned to the fellows and others, and a course of twenty lectures was the result. These were thoroughly worked up from the original articles in the journals, and not from works on the history of chemistry. Full abstracts of these lectures, together with complete references to the articles consulted, are to be prepared and preserved in the chemical library. The lectures given were as follows:

Two by Mr. E. H. Keiser on "The History of Ozone";
Two by Mr. D. T. Day on "The Electro-Chemical Theory";
Four by Mr. W. C. Day on "Avogadro's Hypothesis";
Three by Mr. H. N. Stokes on "The Idea of the Radical in Chemistry";
Three by Professor Remsen on "Valence";
Three by Dr. J. R. Duggan, on "Fermentation";
Three by Dr. R. D. Coale on "The Investigations which led to our present Conceptions of Substitution."

In addition, the work of the year has consisted of the courses below mentioned:

Laboratory Work for undergraduates through the entire year, conducted by Professor Remsen, Dr. Morse, and Dr. Coale.

Lectures by Professor Remsen:
  General Chemistry (Non-Metals), *five times weekly, first half-year.*
  Chemistry of the Compounds of Carbon, *five times weekly, second half-year.*

Courses by Dr. Morse:
  General Chemistry (Non-Metals), *five times weekly, second half-year.*
  Mineralogy, lectures and laboratory work, *three times weekly, first half-year.*

During the second half of the year the work in Mineralogy has been under the charge of Dr. G. H. Williams.

Six numbers of the AMERICAN CHEMICAL JOURNAL have appeared within the year. These are Nos. 3, 4, 5, 6 of Vol. IV, and Nos. 1 and 2 of Vol. V.

BIOLOGY.

PROGRAMME FOR 1883-84.

I. Collegiate Instruction.

This is designed especially for undergraduate students, but graduate students who have not had a thorough preliminary training will be required to follow the instruction in those subjects of the college course in which they are found to be deficient, before undertaking advanced biological studies or engaging in original research.

First Year (Minor) Course.

This has been planned to meet the needs: (1) of those who intend ultimately to take up some one branch of Biology (Zoölogy, Physiology, or Botany) for special study; (2) of students, graduate or undergraduate, who expect later to study medicine, but meanwhile desire, as a valuable preparation, to obtain some general knowledge of the phenomena, laws, and conditions of life; (3) of those who desire, as a part of their general college training, some acquaintance with the modes of thought and the methods of modern experimental and observational science, and select Biology as a subject of study with that end in view.

The course consists of five lectures or recitations weekly throughout the academic year, with laboratory work. The laboratory work takes the place of the greater part of the outside reading required in connection with most other undergraduate courses in the university. The following subjects form together the year's work.

1. General Biology.

Three lectures or recitations weekly from the commencement of the session until the middle of April.

Attention is mainly directed to the broad characteristic phenomena of life and living things rather than to the minutiæ of descriptive Botany or Zoölogy, or the characters of orders, genera, and species. In the laboratory the student learns how to observe, how to verify and describe what he observes, how to dissect, and how to use a microscope; he examines selected vegetable and animal types, from unicellular organisms, as the yeast-plant and Amœba, to the fern and the flowering-plant on one side, and the crayfish and a mammal on the other. In the lecture room attention is mainly given to the fundamental biological facts and laws which the particular plant or animal under consideration is fitted to illustrate, the object being rather to give the student an idea of what is meant by a living thing, by a plant, by an animal, by tissue differentiation, life history, organ, functions, etc., than to teach him the elements of Botany and Comparative Anatomy as commonly understood. The organisms studied are Torula, Protococcus, Amœba, Bacteria, Penicillium, Mucor, Spirogyra, Nitella, a moss, a fern, a flowering-plant, Infusoria, Hydra, starfish, earthworm, crayfish, clam, squid, cartilaginous fish, frog, terrapin, pigeon, and rat; so that at the close of the course the student has a practical knowledge of a typical example from each of the main divisions of animals and plants, on which to base his further reading.

2. The Embryology of the Chick.

Four lectures or recitations weekly from the middle of April until the close of the session.

In this course the student, who has already in his General Biology observed the natural arrangement of animals and plants in diverging series ranging from a simple bit of living matter to highly complicated organisms, studies the individual development of one of the higher animals, from its start as an almost formless bit of living matter to its final highly complex structure. The increasing differentiation of tissues and organs which he has noted as higher and higher plants and animals were dissected, he now sees exemplified by study of his sections of the embryo in different stages of development. At the same time a good foundation is laid for subsequent advanced study in Vertebrate Morphology.

3. Osteology, Human and Comparative.

Two lectures or recitations weekly until the end of March, with practical study on selected skeletons.

The student begins with the human skeleton, which, as the most minutely and accurately described of all conveniently accessible animal structures, is well fitted to train him to observe closely and accurately. He then studies a skeleton from each of the chief orders of the Mammalia and two or three from each of the remaining main groups of Vertebrata.

4. Plant Analysis.

Practical instruction and excursions twice weekly in April and May.

The student is taught how to collect and preserve plants; and, by the analysis of a number of flowering plants under the direction of his teacher, gets a good introduction to the terminology of descriptive botany, and learns how to use a botanical key for the recognition of species.

Second Year (Major) Course.

This is designed for those who, having completed the above minor course, desire to proceed farther with biological studies. Ultimately the second year's work in biology will be, at the choice of the student, one of three courses; in the first of these Animal Physiology will be the dominant study; in the second, Animal Morphology; in the third, Botany; for the present a choice is only offered between the first and second of the three.

[To complete his major course a student must, after finishing his minor, take either 1 and 2 of the subjects below named, or 1, 3, and 4. The combination of 1 and 2 is especially fitted for those who intend afterwards to study medicine].

1. Mammalian Anatomy.

Two lectures or recitations weekly from the commencement of the academic year until the end of January.

In connection with this course the student dissects one of the higher mammals with all the minuteness with which the human body is dissected in a medical school. He thus not merely learns how to dissect thoroughly, but acquires a knowledge of the names, general distribution and structure of nearly all the muscles, nerves, vessels, and viscera, and becomes fitted to take up profitably the professional study of the details of descriptive and regional Human Anatomy, and so saves much time when he afterward enters a medical school.

2. Animal Physiology and Histology.

Three lectures or recitations weekly until the end of January; afterwards five weekly until the close of the academic year.

This course is designed to give the student a good knowledge of the healthy properties and mode of working of the various tissues and organs of the higher animals, man included; also to give him a good knowledge of their microscopic structure. In the laboratory each student examines for himself the histology of each organ and tissue, and thus learns the use of reagents and embedding materials, the methods of mounting specimens, etc.; he also studies practically the composition of the more important organs and tissues, the chemistry of digestion, the fundamental properties of living muscles and nerves, the beat of the heart, the phenomena of reflex action, etc. Important physiological facts, which require special skill for their exhibition or the employment of especially delicate instruments, are demonstrated to the class. There will be, as a rule, one such demonstration weekly.

3. Animal Morphology, or Comparative Anatomy.

Three lectures or recitations weekly from the beginning of December until the end of the academic year.

A systematic course of lectures on the structure, development, relationships, and classification of animals. In the laboratory the student will dissect a number of forms selected especially with a view to illustrating important morphological facts.

4. Marine Laboratory.

Two months study at the marine laboratory of the University, between June 1st and August 31st.

This may be taken in one year or a month may be taken in each of two consecutive years.

II. University Instruction and Opportunities.

This is designed for graduates who have already such a knowledge of Biology as might be obtained by following the collegiate major course in that subject, and for others who, although not graduates, satisfy the university authorities that they are competent to undertake advanced work. In the university courses but little of the teaching is given by formal lectures; the instructors come into close daily contact with the students, supervise their work, direct their researches, and advise as to their reading.

1. Physiology.

The new biological laboratory, which will be opened next September, has been especially constructed with reference to providing opportunity for advanced work in experimental physiology. The collection of physiological instruments belonging to the University is unusually large and complete and is yearly added to; the Trustees providing an annual sum for the purchase of instruments wanted for any particular investigation, or which for other reasons it is desirable to have in the laboratory. There is also a well-fitted-up workshop in the laboratory in which a skilled mechanic is kept constantly at work repairing and cleaning instruments and making new ones. The laboratory contains two large rooms for general advanced work in animal physiology, in addition to others specially designed for work with the spectroscope, with the myograph, for electro-physiological researches, and for physiological chemistry.

2. Histology.

The laboratory contains a special room constructed for advanced histological work, and well supplied with apparatus and reagents. There is also a room for micro-photography.

3. Animal Morphology.

Rooms for advanced work in this subject are also contained in the laboratory; the chief advanced study in it is however carried on at the Marine Laboratory, open at the seaside from the beginning of June until the end of August, under the direction of Dr. Brooks. The marine laboratory possesses a steam launch, and is supplied with the necessary dredges, boats, aquaria, microscopes, etc.

4. Psycho-physiology.

From early in February until the end of the academic year a course of lectures on psycho-physiology, combined with laboratory work, will be given in the biological laboratory by Dr. G. Stanley Hall, in connection with the psychological courses of instruction in the university.

5. Lectures.

Short advanced courses of lectures are given from time to time on selected physiological and morphological subjects.

6. Journal Club.

A Journal Club, composed of the instructors and advanced students, meets weekly for the reading and discussion of recent biological publications.

7. Library Facilities.

The laboratory contains a library supplied with standard biological works and complete sets of the more important journals. There is also a special collection of books which have been brought together in connection with researches carried on in the laboratory. An effort is always made to procure for anyone engaged in a particular investigation, all publications bearing on his work but not easily accessible, as graduation theses, occasional publications from laboratories in Europe and elsewhere, etc. The biological library also receives regularly about forty biological periodicals, including all the important physiological and morphological journals in English, French, German, and Italian.

The general library of the University receives all the chief journals of general science, and the transactions of all the leading learned societies of the world.

The library of the Peabody Institute, within five minutes walk of the University, contains complete sets of many of the chief biological journals, of the proceedings of learned societies, and other works of reference.

In the library of the Medical and Chirurgical Faculty of Maryland, a very large number of medical periodicals is accessible to members of the University.

The proximity of Washington is of special value to advanced students of physiology. The Library of the Army Medical Museum in that city contains an almost unrivalled store of physiological works which are available under conditions most favorable to study.

8. Publication.

In connection with the biological laboratory there is published a journal ("*Studies from the Biological Laboratory*") which contains the results of most of the researches carried out in the laboratory; a ready means of publication for original work is thus secured. The *Journal of Physiology* is published in America under the auspices of the Johns Hopkins University, and affords a desirable medium for the publication of physiological researches. The *University Circulars*, which appear at brief intervals throughout the year, are available for preliminary statements, securing priority for discoveries while more detailed accounts are in course of publication.

III. Naturalists' Field Club.

This was organized by members of the University, but includes in its list of members other residents of Baltimore interested in Natural History. The club works in three sections—Geology and Mineralogy, Zoölogy, Botany. Each section elects its own officers and arranges for its own field excursions and its own meetings. There are also monthly meetings of the whole club, when the chairmen of the different sections report progress and an address on some topic of Natural History is given by one of the members.

The mineralogical collections of the club are preserved in the Chemical Laboratory; the botanical and zoölogical in the Museum of the Biological Laboratory.

WORK OF THE PAST YEAR, 1882-83.

I. Laboratory Work.

The Biological Laboratory has been open for eight hours daily during the year, for the prosecution of advanced study and research and for courses of practical instruction in connection with classes.

During the year original investigations, the results of which either have been or soon will be published, have been made in the following subjects:

ANCIENT AND MODERN LANGUAGES.

PROGRAMME FOR 1883-84.

GREEK.

I. Greek Seminary.

Professor Gildersleeve will conduct the Greek Seminary, the plan of which is based on the continuous study of some leading author or some special department of literature.

The Seminary consists of the Director, Fellows, and Scholars, and such advanced students, to the number of six, as shall satisfy the Director of their fitness for an active participation in the work, by an essay, a critical exercise or some similar test of attainments and capacity. All graduate students, however, may have the privilege of attending the course.

During the next academic year the study of *Greek Historiography* will constitute the chief occupation of the members. There will be two meetings a week during the entire session, one for the criticism and interpretation of the author in hand, one for auxiliary studies. Especial attention will be paid to the development of historical style and method.

The student should possess Herodotos, Thukydides, Xenophon, and Polybius, together with Schaefer's Quellenkunde der Griechischen Geschichte and Hicks's Greek Historical Inscriptions.

Arrangements will also be made for the study of Pausanias under the general guidance of the Director.

II. Advanced and Graduate Courses.

1. **Professor Gildersleeve** will also conduct a course of *Practical Exercises in Greek*, consisting chiefly in translation at dictation from Greek into English and English into Greek, two meetings a week, from the beginning of the session to the first of January. Advanced undergraduates will be admitted to this course upon the recommendation of their advisers.
2. **Professor Gildersleeve** will interpret select tracts of *Lucian* once a week after the first of January.
3. **Professor Gildersleeve** will also give a course of lectures on the *Syntax of the Greek Cases*.
4. Notices as to other courses are reserved.

III. New Testament Greek.

Mr. J. Rendel Harris will give the following courses:

1. Textual Criticism.
2. The Catholic Epistles.
3. The Shepherd of Hermas.
   Twice weekly, through the year.

IV. Undergraduate Courses.

1. Lysias, *Select Orations.*
   Four times weekly, first half-year. **Dr. Spieker.**
2. Homer, *Odyssey* IX-XII; Euripides, *Alcestis.*
   Four times weekly, second half-year. **Dr. Spieker.**
3. Thucydides, VII.
   Four times weekly, first half-year. **Professor Morris.**
4. Aristophanes, *one play;* Sophocles, *Philoctetes.*
   Four times weekly, second half-year. **Professor Morris.**
5. Prose Composition.
   Weekly exercises in connection with each of the above courses.
6. **Professor Morris** proposes also to meet once or twice a week, at some convenient hour, such students as may be inclined to read the Homeric poems in Greek.
   This course is not for the purpose of critical study or grammatical analysis, but merely for the enjoyment of the poems. It will call for no preparation, and may be attended by all who have a moderate acquaintance with the Greek language.

Private Reading. Students having the time are encouraged to pursue parallel courses of private reading under the direction of the instructor. Those who pass examinations on such work will be able to complete their courses in shorter time than otherwise. Examinations on the following books will be provided for 1883-4:

1a. Xenophon, *Hellenica*, I, II.
2a. Herodotus, *Merry's Selections.*
3a. Demosthenes, *in Timocratem.*
4a. Aeschylus, *Septem* or *Persae;* Euripides, *Hippolytus.*

Note.—The work provided for subsequent years will be arranged on a similar scheme, although the books offered will be different. Examinations on the courses in Private Reading will be held at the end of each half-year. Class courses 1 and 2 are to be taken as the first year's work, with 1a and 2a of Private Reading. The second year's work will consist of 3 and 4, with 3a and 4a of Private Reading. Should any student be unable to do the Private Reading in connection with his class work, he may take the examination on Private Readings or extra courses of class work in a subsequent year. One course of class work is in all cases considered the equivalent of two courses of parallel reading.

LATIN.

I. Latin Seminary.

Dr. Warren will conduct the Latin Seminary. The *Plays of Terence* will form the centre of work. There will be two meetings a week throughout the year, one of which will be devoted to the interpretation of selected portions of the text which present critical difficulties, the other to the consideration of more general topics connected with the syntax, metres, and literary history of the Latin comedy, and to the discussion of papers presented by the members of the Seminary.

Students are advised to provide themselves in advance with Umpfenbach's critical edition of Terence (Berlin, 1870). Spengel's edition of the Andria (Berlin, 1875) and Dziatzko's edition of the Phormio (Leipzig, 1874) and Adelphoe (1881) will also be found useful. Klotz's edition of Terence (2 vols., 1838-40, Leipzig) is also valuable, as it contains the commentaries of Donatus and Eugraphius of which constant use will be made.

An effort has been made to furnish the Seminary Library as completely as possible with the more important editions and dissertations bearing directly or indirectly on the study of Terence.

3. Classics.
   Prose; One play; Minor Poetry. *Twice weekly.*
4. Exercises with Whitney's Grammar.
   Weekly.

II. Second Year (Major) Course.

5. Middle High German.
   Paul's and Weinhold's Grammars; Reading of Epic Poetry. *Twice weekly.*
6. German of the XVI and XVII centuries.
   Brant's *Narrenschiff*, Luther's "*An den Adel,*" Gryphius's *Peter Squenz*. *Twice weekly* (*one half-year*).
7. *a.* Deutsche Stilübungen.
   Monthly.
   b. Prose Composition.
   Whitney's and Paul's Grammars. *Weekly.*
8. History of German Literature.
   Lectures in German, Kluge's *Deutsche Nationallitteratur.* *Once in two weeks.*
9. Reading of German Classics (1765–1832).
   Four times weekly.

NOTE.—Students have some choice, under the direction of the instructor, in making out courses. Thus a first year's course may be made up of 1, 3, 4; of 1, 2, 4; of 2, 3, 4. A second year's course might consist of 6, 7*b*, 8, with the whole of 9, first half-year, and two hours of 9, second half-year; of 5, 6, 7*a*, 8, and two hours of 9; of 6, 7*b*, 8, 2, and three hours of 9; of 6, 7*b*, 8, 1, and three hours of 9.

ENGLISH (including Anglo-Saxon).

(*Further announcements of the advanced courses will be made later.*)

DR. WOOD will conduct the following courses:

1. Anglo-Saxon.
   Sweet's Reader. Selected Texts in Anglo-Saxon Law. Lectures. DR. WOOD. *Twice weekly, through the year.*
2. Early English (1200–1400 A. D.)
   Morris and Skeat's Specimens, Parts I. and II. DR. WOOD. *Twice weekly, through the year.*
3. Chaucer.
   Prologue, etc., ed. Morris. Prioresses Tale, etc., ed. Skeat. DR. WOOD. *Once weekly, through the year.*
4. Elements of English Phonetics and Language Building.
   Sweet's Hand-book. Exercises. DR. WOOD. *Once weekly, first half-year.*
5. He will also conduct grammatical and rhetorical exercises for students in the first and second year's courses in English.
   Through the year.

DR. BROWNE:

6. Will receive and correct such essays as may be submitted to him by any member of the undergraduate or graduate courses.
   Every undergraduate will be required to write and submit to him such a number of exercises as shall seem sufficient to secure good ability in writing English.
7. Will meet undergraduates who do not take the full English course, and will read with them selections from English Literature, with critical and historical comments.
   Twice weekly, through the year.
8. Will meet those students who take the full English course, and will read with them (*a*) Shakspeare's Hamlet, (*b*) Selections from English Prose writers since Bacon.
   Twice weekly, through the year.

9. There will be a class course in the history of the English Language.
   Lounsbury's History and Marsh's Lectures will be used as text books.
   Once weekly second half-year.
10. PROFESSOR CORSON, of Cornell University, will give a course of twenty public lectures on the History of English Literature, beginning January 21.
11. MR. WOODWORTH, will meet students daily for training in Vocal Culture.

NOTE.—The first year's course will consist of 3, 4, 8 and such part of 5 and 7 as the instructor shall think advisable; the second year's course of 1, 2, 10, and one hour of 5.

ROMANCE LANGUAGES.

I. For Advanced and Graduate Students.

MR. ELLIOTT.

1. Anglo-Norman French, (xii and xiii centuries).
   The Laws of William the Conqueror and Chardry's *Josaphas* (Koch's edition) will be taken up and studied in their linguistic relations to English on the one hand and to the French proper, (Isle-de-France), on the other. Literary history of the Anglo-Norman period. *Weekly, through the year.*
2. Provençal.
   Exercises in Bartsch's *Chrestomathie provençale*, for the xiii century language. Special comparison of the old idioms with the modern South French dialects. *Weekly, through the year.*
3. Romance Dialects.
   Spanish and Portuguese. Lectures. Practical exercises in the Langue d'oïl dialects. *Weekly, through the year.*
4. Comparative Grammar of the Romance Languages.
   Lectures. *Weekly, through the year.*
5. Ladinian Idioms.
   Ulrich's Chrestomathy. *Weekly, first half-year.*
6. Wallachian.
   Practical exercises, with observations on the dialect differences of the language, and its relation to the other members of the Romance Group. *Weekly, second half-year.*
7. French Philology.
   Brachet's *Grammaire historique.* French Phonetics. *Twenty lectures.*
8. French Literature of the Middle Ages.
   Twenty lectures.

II. French—For Undergraduates and Beginners.

The usual classes will be provided for undergraduates. Announcements on this subject will be made at a later date.

Ancient and Modern Languages (continued).

WORK OF THE PAST YEAR, 1882-83.

I. Greek.

Under the direction of Professor Gildersleeve the advanced students of Greek have been organized into a Greek Seminary. According to the plan of the seminary the work of each year is concentrated on some leading author or some leading department of literature. During the past year the centre of work has been Aristophanes.

In the seminary proper, which met twice a week during the academic year, the Wasps and the Frogs were interpreted by the members in turn and all the plays except the Lysistrata were analyzed and introductory lectures prepared by different members of the seminary. Studies were made in Aristophanic syntax and papers were read not only on syntactical topics but on the First and Second Plutos, on Proverbs in Aristophanes, on Aristophanes' theory of comic art, on the character of Kleon, on the proportion of chorus and dialogue in Aristophanes, on Philonides and Kallistratos. Work begun the preceding year was carried on, notably an elaborate study of the predicative participle in Attic prose, of which an abstract is given in *Circular No.* 22. In connection with the work of the seminary, Professor Gildersleeve conducted weekly readings during the latter part of the academic year in the Fragments of the Old Attic comedy and delivered twelve lectures on Greek metres with especial reference to Aristophanes.

Besides the Seminary course proper, Professor Gildersleeve delivered thirty-two lectures on the Hypotactic Sentence, interpreted select odes of Pindar, conducted twenty-two exercises in translating at dictation from Greek into English and English into Greek, and held a series of six conferences with undergraduate students in which the leading principles of Greek literary art were set forth, with illustrations drawn from the courses pursued in the undergraduate department.

A course in the comparative study of Greek inflections was conducted by Dr. Bloomfield.

This was initiated by a course of seven formal lectures, whose aim it was to exhibit the precise degree of certainty which attached itself to the most important theory of Indo-European language-history, namely, the theory of agglutination. It was shown that there are grave difficulties in its way, but that on the whole it afforded as yet the only satisfactory explanation propounded for the phenomena of our languages in historical times. The rest of the course was carried on under seminary organization; the origin and form of the verbal inflectional elements being the subject which received most attention. Throughout the year this work was supplemented by the lectures of the instructor.

Mr. Harris has conducted a class-course in New Testament Greek, twice weekly, through the year, and has given two public courses, one, of six lectures, on the Greek of the New Testament, with an average attendance of 73, and the other, of five lectures, on the Epistle to Diognetus, with an average attendance of 58.

Additional courses were conducted during the year by:

Professor C. D. Morris, in

Plato: *Phaedo, four times weekly, first half-year.*

Aeschylus: *Prometheus;* Euripides: *Medea, four times weekly, second half-year.*

Dr Spieker, in

Xenophon: *Cyropædia, four times weekly, first half-year.*

Homer: *Iliad,* xvi-xix, *four times weekly, second half-year.*

Classes in Greek Prose Composition were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Xenophon: *Convivium* (3).
Herodotus: *Selections* (3).
Demosthenes: *In Leptinem* (3).
Isocrates: *Panegyricus* (2).
Plutarch: *Themistocles* (2).
Aristophanes: *Plutus* (2).
Sophocles: *Electra* (2).

II. Latin.

The Latin Seminary, under the direction of Dr. Warren, held two sessions a week throughout the year, the author selected for special study being Cicero, one hour weekly being devoted to the Orations, and one to the Letters.

A preliminary course of six lectures was given on Cicero's Life with special reference to his oratorical training and literary development. It was endeavored to show that certain marked differences existed between the style and language of the earlier and the later orations, and the lines which an investigation into such differences must follow were pointed out. The general characteristics of the epistolary style were discussed, an account given of the several collections of Cicero's Letters, their discovery in modern times, and the views now held in regard to the chief manuscripts. The orations were taken up in chronological order,—more particular attention being paid to the Pro Publio Quinctio, pro Roscio Comoedo, in Cæcilium Divinatio, in Verrem Actio Prima, pro Milone, and Philippica II. Analyses of speeches were prepared by members of the seminary; the commentary of Asconius to the pro Milone was carefully studied, and a large portion of the pro Roscio Amerino was made the subject of critical interpretation. In the early part of the year several of the more difficult letters were taken up, on which members were required to present in turn a critical and exegetical commentary. Students were encouraged to do as much outside reading as possible, and after some acquaintance had been gained with the letters of Cicero, the attention was mainly directed in the latter part of the year to the letters of Cicero's correspondents. The letters of Sulpicius, Vatinius, Dolabella, Curius, Caelius, Plancus, and Marcellus were assigned to different members, and the results of detailed investigations into their peculiarities were embodied in papers and presented to the seminary. Papers were also read during the year on the characteristics of Vulgar Latin and on various points connected with the syntax of Cicero's letters.

Dr. Warren also lectured weekly in the latter part of the year to advanced and graduate students on Historical Latin Grammar, with especial reference to the genesis of forms and to phonetic laws.

Additional courses have been conducted during the year by:

Dr. Warren, in

Cicero de Finibus, *weekly, first half-year.*
Lucretius, *three times weekly, first half-year.*
Livy, *four times weekly, first half-year.*
Plautus; Terence, *four times weekly, second half-year.*

Professor C. D. Morris, in

Tacitus: *Histories, four times weekly, first half-year.*
Crowell's Selections from the Latin Poets, *four times weekly, second half-year.*

Dr. Spieker, in

Cicero: *Tusculan Disputations, three times weekly, first half-year.*
Horace, *four times weekly, second half year.*

Classes in Latin Prose Composition were also conducted by each of the instructors in connection with the courses above named.

Students have privately read for examination the following books:

Livy: *Bks.* VI, VII (1).
Tacitus: *Germania*, *Agricola* (1).
Cæsar: *Civil War* (7).
Cicero: *De Natura Deorum* I (6); *De Senectute* (8).
Quintilian: *Bk.* X (1).
Pliny: *Select Letters* (1).
Ovid: (2).
Vergil: *Georgics* (2).
Horace: *Epistles* I, II, *Ars Poetica* (1).
Terence: *Phormio*; *Hautontim.* (5).
Lucretius: *Bk.* V (4).

III. Sanskrit and Comparative Philology.

In Sanskrit, one elementary and three advanced courses were conducted by Dr. Bloomfield, who also instructed a beginners' class in Hebrew during the second half-year.

After a course in Whitney's Grammar, the first part of Bopp's Nala was read by the elementary class, which met twice weekly. One of the advanced classes, meeting weekly, read two episodes of the Kathâsaritsâgara.

A second class, meeting twice weekly, followed a course introductory to the Vedas. In the beginning a short course of lectures was given sketching the position of the Vedas in the history and literature of India. Throughout the rest of the year there were read hymns of the Rig-Veda characteristic of the life, the religion, and customs of the earliest Indian period. Particular attention was given to the relation of the language of the earliest Veda to that of the common or classical Sanskrit.

A course in Comparative Grammar of Sanskrit was carried on in the following manner. The subject chosen for treatment was the representation of the two Indo-European series of gutturals especially in Sanskrit but with constant reference to the nearer relatives of the Indian languages, especially the Zend, and the Greek. The more important investigations on this subject were made the basis of the discussion, but these were constantly supplemented by the lectures of the instructor.

A statement of the course in the comparative study of Greek inflections is made under Greek above.

The class in Hebrew followed a course through Davidson's grammar, and afterward the reading and analysis of the first chapters of Genesis were entered upon.

IV. German.

Advanced Courses were conducted as follows:

Gothic. *Weekly first half-year, and twice weekly, second half-year.* DR. WOOD.
Old High German. *Twice weekly.* DR. BRIGHT.
Middle High German. *Twice weekly.* MR. RADDATZ.
History of German Literature, consisting of lectures in German. *On alternate Saturdays.* DR. WOOD.
Deutsche Stilübungen and Essays. *Monthly.* MR. RADDATZ.
Reading of the classical authors. *Four times weekly.* DR. BRIGHT.
Prose Composition. *Weekly.* MR. RADDATZ.
German Syntax. *Three times monthly.* MR. RADDATZ.

The Minor Course classes were instructed by Dr. Wood and Dr. Bright four times weekly.

Selections were read from Schiller's, Goethe's, and Humboldt's Prose, Dahn's *Urgeschichte der germanischen und romanischen Völker*, Hodges' *Scientific German* and Goethe's *Egmont*, and one exercise was given weekly in grammar and prose composition.

Students have read privately for examination:

Schiller's *Wallenstein* (1), *Tell* (2), *Neffe als Onkel* (15).
Gryphius' *Peter Squenz* (1).
Middle High German. Selections from Weinhold's Reader (1).

V. Anglo-Saxon and English.

Dr. Wood has met two advanced classes in Anglo-Saxon and Early English, each twice weekly.

He has read with them Sweet's Anglo-Saxon Reader, part of Cynewulf's Elene, and Specimens of Early English, ed. Morris and Skeat, Pt. I. To the same classes he also lectured, once weekly, first half-year, on Comparative Anglo-Saxon Grammar. In the second half-year, a second hour weekly in Gothic (see German courses) was substituted for the weekly hour in Old-Saxon announced.

There was also a bi-weekly meeting of the advanced students under the direction of Dr. Wood during the second half-year, at which papers were read, brief reports presented, and the contents of recent scientific journals discussed.

Besides these, the following less advanced classes, including the Minor Course classes, have been conducted by Dr. Wood.

Anglo-Saxon for beginners. *Weekly.*
Chaucer, The Prologue, etc., ed. Morris. *Twice weekly, second half-year.*
Shakspeare, Macbeth. *Weekly, first half-year.*
English Phonetics, Sweet's Hand Book. *Weekly, first half-year.*

Dr. Browne has met, twice weekly, a class for reading works by the best English Prose Writers. Selections from Burke, Fitz-James Stephen, and Defoe have been read. Essays have been written monthly by each member of the class, and have been corrected and commented upon by the instructor.

VI. Romance Languages.

Advanced Courses were conducted by Mr. Elliott as follows:

Old French—The *Passion du Christ* (x century) was taken up and its mixed dialect character particularly studied in its linguistic relations to both the Provençal and Langue d'oïl types. *Twice weekly, first half-year.*
Old Franco-Norman Dialect.—The *Vie de Saint Alexis* (xi century) and Wace's *Roman de Rou* (xii century) were examined in their relation to English and to the French proper. *Twice weekly, second half-year.*
Provençal.—Extracts from Bartsch's *Chrestomathie Provençale* confined to the xii century language with practical exercises and special comparison with the Latin and the other Romance idioms, in phonetics and morphology. *Weekly, through the year.*
Romance Dialects.—Lectures and practical exercises in the Italian and Provençal dialects. *Weekly, through the year.*
Portuguese.—Os Lusiadas de Camões was read with special reference to the language of this period as compared with the Spanish and Latin. *Weekly, through the year.*
Italian.—Dante. *Twice weekly, first half-year.*
Spanish.—Don Quijote. *Twice weekly, second half-year.*

Mr. Marcou conducted courses in

Old French. *Twice weekly, through the year.*
French Literature. *Weekly, through the year.*

Mr. Marcou also conducted the Minor Course classes in French, which met seven times weekly.

The reading embraced Fustel de Coulanges, *La Cité Antique*; Elisé Reclus; Molière; Victor Hugo; etc., and there was one exercise weekly in grammar and prose composition.

Two public courses on French Literature, including twenty-two lectures (in French), were given by Mr. Rabillon, with an average attendance of thirty-seven. He also conducted classes in French conversation and composition and in the rudiments of French.

The **JOHNS HOPKINS PHILOLOGICAL ASSOCIATION** has met monthly as heretofore. Papers have been read during the session by

W. J. ALEXANDER, on Mathew Arnold's poetry test; participial periphrases in Attic prose.

M. BLOOMFIELD, on a search for functional and dialectic differences in the present systems of the Veda; Arthur C. Burnell and the Talavakāra Brāhmana; the general theory of Greek accentuation; the etymology of φίλος.

J. W. BRIGHT, on a fragment of the Cura Pastoralis.

A. M. ELLIOTT, on functional differences of the past participle in the periphrastic perfects of the Latin, old and modern French.

A. EMERSON, on the so-called dying Alexander of the Uffizi Gallery.

B. L. GILDERSLEEVE, on aesthetic and grammar; on the symmetrical structure of the Pindaric odes.

J. R. HARRIS, on the locality of the treatise of Palladius de Agricultura; "New Testament autographs"; the normal forms of the Pliny and Cicero letters; notes on the stichometry of Euthalius.

H. C. G. JAGEMANN, on the second mutation of consonants in French; some points in the relations of the Norman dialects to English pronunciation.

P. B. MARCOU, on French syntax as affected by the cultivation of style.

C. D. MORRIS, on a probable error in Plutarch; a note on the Chalkidians; on the Athenian jurisdiction over the allies.

B. F. O'CONNOR. Review of Professor Harrison's French Syntax.

E. H. SPIEKER, on the use of ὅτι (or ὡς) in direct quotations.

A. H. TOLMAN, on quantity in English verse and the use of the hexameter; the laws of tone-color in the English language.

M. WARREN, on the importance of Latin glossaries with special reference to Codex Sangallensis, 912, Saec. VII–VIII; on a Plautine pun.

The third volume of the **AMERICAN JOURNAL OF PHILOLOGY** has been completed during the year, and the second number of the fourth volume is now in press.

HISTORICAL AND POLITICAL SCIENCE.

PROGRAMME FOR 1883-84.

I. Graduate and Advanced Courses.

1. Seminary of Historical and Political Science.

   The Seminary, for the coöperative study of American Institutional History and Economics, is conducted by Dr. H. B. Adams and composed of the Instructors and advanced students in this department. *Two hours weekly.*

2. Sources of American Colonial History.

   This will be a class course for practical training in the use of colonial laws, archives, and documentary history of the older states of the American Union. The class will meet in the library of the Maryland Historical Society by the courteous permission of the authorities of the Society; particular attention will be given to the State Papers of Maryland, which have lately been transferred from the Land Office at Annapolis. The Society has always accorded free access to its valuable collections to students of the University. *Once weekly, first half-year.*

3. Sources of American Constitutional History.

   This course, like the preceding, will be one of practical instruction in the use of original sources of American History, but with special reference to the origin and development of the Constitution. The class will meet in one of the rooms belonging to the Maryland Historical Society, and will study the political and economic questions which held the states together after the close of the American Revolution, together with other formative influences, which led to the adoption of the present Constitution. *Once weekly, second half-year.*

4. Advanced Course in Political Economy.

   This course will be conducted by Dr. R. T. Ely. The first half of the course will consist of lectures on the Principles of Economics, with special reference to such practical problems as the Tariff, Coöperation, Strikes, Immigration, etc. The second half will comprise lectures on Social Movements in Europe and America during the eighteenth and nineteenth centuries. *Thrice weekly.*

5. Taxation in America.

   Ten class-lectures will be given by Dr. Ely upon American Taxation, with special reference to States and Cities.

6. English Socialism.

   Four lectures will be given by Dr. Ely on Social Movements in England in the nineteenth century. This course will deal especially with Robert Owen and English Communism, Anti-Corn-Law Agitation, Chartism, and Christian Socialism.

NOTE.—Graduates and advanced students are expected to have sufficient command of French and German to enable them to read historical and political works in those languages; persons deficient in this regard are advised to begin the study of those languages at once. Classes in French and German historical prose, also in Anglo-Saxon, will be in progress through the year. Graduates who so desire may take any portion of the following courses; but undergraduates will not be admitted to any of the advanced courses, except No. 3, on American Constitutional History, and No. 6, on English Socialism.

II. Undergraduate Courses.

1. Introductory Historical Course (required of all).

   At matriculation, all students must pass an examination in the general history of England and the United States. After passing this test, all undergraduates are required to take the Introductory Historical Course, which comprises:

   (*a*) Twelve Lectures on the Origin of Civilization, by Dr. H. B. Adams.

   (*b*) Twenty Class Exercises in Physical and Historical Geography, with Dr. J. F. Jameson.

   (*c*) History of Greece and Rome, with Dr. J. F. Jameson. *Twice weekly, through the year.*

2. Two Years' Course in History.

   Five exercises weekly.

   FIRST YEAR:

   (*a*) Livy.
   (*See Latin courses, p.* 129).

   (*b*) Tacitus.
   (*See Latin courses, p.* 129.)

   (*c*) Thucydides.
   (*See Greek courses, p.* 128).

SECOND YEAR:

(*a*) Lectures on Early Church History, Mediaeval Empire, the Italian Renaissance and the German Reformation, by Dr. H. B. Adams.
Twice weekly, through the year.

(*b*) Class Exercises in French and English History, by Dr. J. F. Jameson.
Three times weekly, through the year.

NOTE.—Either half of this two years' course may count for a Minor course in History, provided the Introductory Historical Course has been successfully taken. The first half of the Major Course in History consists of one year's class-work in Livy, Tacitus, and Thucydides, with special reference to historical culture and literary form. This study of the original sources of important periods in Greek and Roman history, may be pursued in the same year as the Introductory Historical Course, but the second part of this Major Course must follow the Introductory course, although it may be taken without the classical course; in this case, a Minor in History can be counted.

3. Two Years' Course in Political Science.
Five exercises weekly.

FIRST YEAR:

(*a*) Elements of Political Economy, by Dr. R. T. Ely.
Five hours weekly, first half-year.

(*b*) Historical Systems of Political Economy, by Dr. R. T. Ely.
Five hours weekly, second half-year.

NOTE.—It is desirable that students who propose to follow this course should previously read one of the following manuals: Cossa's *Guide to the Study of Political Economy*; Rogers' *Manual of Political Economy*; or Mrs. Fawcett's *Political Economy for Beginners*.

SECOND YEAR:

(*a*) Elements of Roman Law.
Once weekly, first half-year.

(*b*) International Law. Bluntschli's Code, with lectures on International Relations, by Dr. H. B. Adams.
Three times weekly, first half-year.

(*c*) European Constitutions, by Dr. H. B. Adams.
Three times weekly, second half-year.

(*d*) English Constitution (Stubbs' Select Charters), by Dr. J. F. Jameson.
Once weekly, through the year.

(*e*) American Constitution, by Dr. H. B. Adams.
Once weekly, second half-year.

NOTE.—The first year of the course is devoted to Political Economy, which by itself counts as a Minor course, or which may be combined with a History Minor, thus constituting one Major course in Historical and Political Science.

The second year of the course in Political Science may be taken by itself, or it may be combined with one year of History.

A Minor course of one year in History or Political Science requires not only successful examination upon class-work, but the production of at least three essays, which shall be subject to the criticism and approval of the instructor in English, and which shall be read, in part, before the teacher of elocution. A Major course of two years in History or Political Science, requires the production of six acceptable essays, and successful examination upon such course of outside reading as may be prescribed in individual cases.

III. Library Facilities.

Besides the University Library of Historical and Political Science, other libraries, easy of access, are the Library of Congress, the Peabody Library (numbering seventy-nine thousand volumes, and known as "a library of research"), the Library of the Maryland Historical Society (especially rich in *Americana*), the Library of the Baltimore Bar (law reports), and the Maryland Episcopal Library (especially valuable for its original sources of church history).

By the opening of the next academic year, the books on Historical and Political Science will be placed by themselves in commodious rooms. The library, already fairly supplied with the state papers, public documents, statutory law, codes, charters, municipal reports, etc., will be rapidly increased by publications coming from our national, state, and city governments.

IV. Publications.

The Johns Hopkins University Studies in Historical and Political Science will continue to be published in the form of monographs, but with somewhat widening scope. While studies in Local Government will still find place, attention will be directed to City Government in America, and to certain topics of economic as well as institutional interest. A list of the numbers thus far published is given below.

WORK OF THE PAST YEAR, 1882–83.

I. The Seminary.

This class of graduate and advanced students has met Friday evenings throughout the year in two-hour sessions, under the guidance of Dr. H. B. Adams, for original studies in American Institutional and American Economic History.

II. Historical and Political Science Association.

This includes the Seminary and certain gentlemen not directly connected with the University, but coöperating with or aiding its work in Historical and Political Science.

The associate members are a few lawyers, clergymen, teachers, archaeologists, and local historians in Baltimore or Maryland; several non-resident professors, graduate students, and specialists, together with some who have lectured informally before the Association or who have contributed to the University Studies.

During the past year the following gentlemen have addressed the Association: The Hon. John H. B. Latrobe, President of the Maryland Historical Society; Hon. A. D. White, President of Cornell University; Dr. Philip Schaff, of Union Theological Seminary; the Rev. A. D. Mayo; the Rev. G. A. Leakin; Colonel William Allan, Principal of McDonogh Institute; Dr. S. A. Harrison, of Easton, Md.; Hon. A. B. Davis, of Montgomery County, Md.; W. T. Croasdale, editor of *The Day* (Baltimore); Talcott H. Williams, of the editorial staff of *The Press* (Philadelphia).

III. Publications.

A special channel for the publication of the best results of Seminary and Association work has been opened by the University through the Studies in Historical and Political Science, a series of monographs, edited by Dr. H. B. Adams. The aim of this series is to combine kindred contributions to Historical and Political Science in such a way that individual studies may become more useful by reason of association, first, in numbered monographs and, afterwards, in book-form. The special fields that have been chosen for co-operative study are American Institutions and American Economics, both fields to be considered from historical and practical points of view.

An Introduction to American Institutional History was written for the series by Mr. Edward A. Freeman, who, during his visit to Baltimore in November 1881, became interested in the work of the University. Beginning in November, 1882, the "Studies" have been issued every month: they include the Germanic Origin of New England Towns, with Notes on Co-operation in University Work, by the Editor; Local Government in Illinois, by Albert Shaw, A.B.; Local Government in Pennsylvania, by E. R. L. Gould, A.B.; Saxon Tithing Men in America, by the Editor; Local Government in Michigan and the Northwest, by E. W. Bemis, A. B.; Parish Institutions of Maryland, by Edward Ingle, A.B.; Old Maryland Manors, by John Johnson, A. B.; and Norman Constables in America, by the Editor.

Some of the communications to the Seminary during the year have also been printed elsewhere. Two papers on Plymouth, by Dr. H. B. Adams, appeared in the Magazine of American History (December, 1882, and January, 1883); in the same magazine for April, 1883, were papers by Dr. J. F. Jameson and Edward Ingle, the one on Montauk, the other on Maryland Parishes. Dr. R. T. Ely's paper on Money was published in the Banker's Magazine, January, 1883; and his lecture on the Prussian Civil Service appeared in the Overland Monthly for May, 1883. Various minor communications, notes, abstracts, reviews of new books have been printed in newspapers or critical journals.

IV. The Library of Historical and Political Science.

The foundation of a special library of research has been, for the students of Historical and Political Science, one of the most important results of the year, inasmuch as the prosecution of Seminary work and contributions to the Studies are in great measure conditioned by the character and accessibility of library materials.

The collection of State Laws and Colonial Records for the study of American Institutional History was begun in the interests of the University five years ago. In 1882, provision was made for the increase of this collection, and for its establishment in a separate building. At the opening of the last academic year, the Seminary was intrusted with the charge of all books relating to its special fields of Historical or Political Science which belonged to the main Library of the University. In December, 1882, this collection was greatly enlarged by the gift of the library of Dr. J. C. Bluntschli, late professor of constitutional and international law in the University of Heidelberg, a library especially rich in works of Historical and Political Science, and containing about twenty-five hundred volumes, with three thousand pamphlets. The collection had been purchased by the German citizens of Baltimore as a donation to the Johns Hopkins University. This generous gift was soon followed by two large contributions of Government Documents, the first from the Department of the Interior, the second from the State Department at Washington.

V. Advanced Courses.

Class-lectures on the Sources of Early English History were given weekly by Dr. H. B. Adams during the first half-year, and on Comparative Constitutional History (with Bluntschli's "Lehre vom Modernen Stat" as basis), during the second half-year.

These lectures were given in the small lecture-room at the Peabody Institute, where, through the courtesy of the authorities in charge, the privilege has been enjoyed of exhibiting to the class all available books and sources of information mentioned in the lectures. These literary materials were briefly described and then referred to individuals for more detailed examination at the Institute during the week, each man taking some one theme or original authority. Such study led to a course of student lectures, the second half-year, upon special topics connected with the class-work.

Class-lectures on Finance and Administration, three hours weekly throughout the year, have been given by Dr. R. T. Ely.

Particular attention has been devoted to the General Principles of Banking, and Banking in the United States, to monometallism and bimetallism, and to taxation. Each member of the class has written a description of the National Banking System, basing his essay on the banking laws, government documents and such other material as he could command. Papers on monometallism and bimetallism were read before the class by students, and were followed by a discussion. Papers have been written by students on different topics connected with the Financial History of the United States, as the First and Second United States Banks, the Income Tax, National Finances from 1861–5, etc. Beginnings of a series of papers on finance in state and city have been made and will be continued during the coming academic year. Apart from financial administration, attention has been given to the Civil Service in this and other countries and to municipal government.

Six public lectures were given in Hopkins Hall by Dr. Ely upon the History of French and German Socialism, with an average attendance of 110 persons.

These lectures are now in press, and will be published in book-form by Harper and Brothers.

Four public lectures were given by Dr. Adams before the Peabody Institute on Local Life and Home Institutions.

VI. Undergraduate Courses.

An Introductory Historical Course was given by Dr. H. B. Adams, assisted by Dr. J. F. Jameson.

This course consisted of twelve lectures on Oriental History by Dr. Adams, and of class-instruction in the History of Greece and Rome and of Early Europe, by Dr. J. F. Jameson, two hours weekly throughout the year.

A Minor Course in Modern History, for students of at least one year's standing, was conducted by Dr. Adams, five hours weekly throughout the year.

The first part of this course consisted of lectures, essays, and examinations on the Italian Renaissance, with Sismondi's History of the Italian Republics for a class-book, and with a class-library consisting of Symonds, Burckhardt, Villari, Milman, Hallam, etc., for topical reading and reference. The second part of the course was devoted to a study of the Reformation in Germany, Switzerland, France, and England, together with the Revolt of the Netherlands and the Thirty Years' War, with frequent oral and written examinations.

A Minor Course in Political Economy was conducted by Dr. R. T. Ely, five hours weekly throughout the year.

The first part of this course consisted of an exposition of the Principles of Political Economy, with the work of John Stuart Mill as a basis. The second part was a further development of this subject, together with lectures upon Historical Systems of Political Economy.

PHILOSOPHY.

PROGRAMME FOR 1883-84.

I. History of Philosophy and Ethics.

PROFESSOR G. S. MORRIS, during the first half-year

1. Will lecture on the History of German Philosophy, with special reference to the development from Kant to Hegel.
   Three times weekly.
2. Will direct a Philosophical Seminary, with Spinoza's Ethics as the special subject of study.
   Twice weekly.
3. Will give four public lectures on the Ethics of Social Relations.
   Probably in December.
4. Will also conduct a course in Ethics for undergraduates.
   (See Undergraduate Courses below).

BOOKS RECOMMENDED FOR PRELIMINARY READING.

Course 1. Encyclopaedia Britannica, 9th edition, (articles on Descartes, Cartesianism, Leibnitz, Kant, Fichte, Hegel); A. Seth, *From Kant to Hegel*; E. Caird, *The Philosophy of Kant*, (especially the Historical Introduction); J. Watson, *Kant and His English Critics*; Kant, *Critique of Pure Reason* (in "Griggs's Philosophical Classics," Chicago, 1882); W. Wallace, *The Logic of Hegel* (Prolegomena); Seth and Haldane, *Essays in Philosophical Criticism*; K. Fischer, *Geschichte der neueren Philosophie*; Harms, *Die Philosophie seit Kant.*

Course 2. Students should be provided with a copy of the Latin text of Spinoza's Ethics. The Tauchnitz edition (Spinozae Opera, ed. C. Bruder, Vol. I) is suggested as convenient and inexpensive. Attention may be directed, preliminarily, to the bibliography of the subject in Ueberweg's History of Philosophy and also to the following: F. Pollock, *Spinoza, His Life and Philosophy*; J. Martineau, *A Study of Spinoza*; J. G. Prat, *L'ethique de Spinoza, traduite et annotée, Parts I and II*, (Paris 1880-2); F. G. Hann, *Die Ethik Spinoza's und die Philosophie Descartes'*, (Innspruck, 1875); G. Busolt, *Grundzüge der Erkenntnisstheorie und Metaphysik Spinoza's*, (1875).

Course 3. H. Marion, *La Solidarité morale*; Aristotle, *Politics and Economics*; Hegel, *Philosophie des Rechts*; Trendelenburg, *Naturrecht*; E. Mulford, *The Nation*; Lieber, *Political Ethics*; P. Janet, *La Famille*; Ferraz, *Le Socialisme*, (Paris, 1882).

II. Psychology, Etc.

DR. G. STANLEY HALL, during the second half-year

1. Will give a course of at least two lectures weekly, with charts, experiments, etc., in Physiological Psychology.
   This course is intended only for those who have taken the course in general biology, (including the structure of the sense organs and brain), which will end before this course begins.
2. Will direct the work of those engaged in special research.
   A certain number of tables (probably not more than four) will be provided for students who wish to engage in special observation and research in the field of psychical phenomena. To this privilege those only will be admitted who are already experienced in physiological methods. For permission to use a table application should be made to Dr. Hall prior to January, 1884. From the nature of the work comparatively little time daily can be given to it with advantage.
3. Will give a course of at least two lectures per week on Psychological Theories and Ethics.
   This course is designed especially for those who have some fundamental knowledge of the history of philosophy and ethics. Programmes of practical work in this field will be prepared for those who may desire.
4. Will direct a course in Pedagogics.
   A weekly class in the principles of pedagogics will be formed in connexion with lectures elsewhere announced for those intending to teach in colleges and other higher institutions of learning. A select library will be provided, and each member of the class will be expected to prepare and deliver a paper on some appointed topic.
5. Will give five public lectures on educational topics in successive weeks during the spring.

III. Logic.

MR. C. S. PEIRCE.

1. Will give forty lectures to graduate and special students upon General Logic.
   The course will follow the contents of Mr. Peirce's forthcoming treatise on logic. At least one lecture will be devoted to each chapter, but the preferences of the class will be consulted in deciding upon the topics of nine of the lectures. The distribution of topics in the chapters is as follows:
   Generalities (5 chapters).
   Deductive Logic:
      Non-mathematical (3 chapters).
      Algebraic (4 chapters).
      Otherwise mathematical (4 chapters).
   Inductive Logic:
      Theory (9 chapters).
      Illustrations (6 chapters).
2. Will give special courses or private lessons upon any branch of the subject in which any of the graduates or special students may desire instruction.

IV. Undergraduate Courses in Logic, Ethics, and Psychology.

Undergraduates will have the opportunity of following any or all of the courses below mentioned. Similar announcements will be made in future years, so that each undergraduate may take part of his philosophical work in one year and part in another. Examinations will be held at the close of each part of the course.

1. Logic.
   Thirty lessons. MR. J. R. HARRIS.
   Reference books: Whately, *Elements of Logic*; Jevons, *Lessons in Logic*; Mill, *System of Logic.*
2. Ethics.
   Twelve biographical lectures on leading philosophers, ancient and modern. PROFESSOR G. S. MORRIS.
   Reference books: Schwegler, *Handbook of the History of Philosophy*; Ueberweg, *History of Philosophy*; Lewes, *History of Philosophy*; *Philosophical Classics for English Readers*, ed. Knight; *German Philosophical Classics*, ed. G. S. Morris; *English Philosophers*, ed. Müller (Putnams).
3. Ethics.
   Twelve lectures and exercises on Practical Morals. MR. J. R. HARRIS.
4. Psychology.
   Twelve lessons on the Relation of the Mind and Body. DR. G. S. HALL.
5. Psychology.
   A course of lectures on Mental Habits. (To be hereafter announced).

The official publications of the Johns Hopkins University, consisting of the University Circulars, Annual Report, and Annual Register will be sent by mail for one dollar per annum. A list of the scientific journals published under the auspices of the University will be sent on application.

JOHNS HOPKINS UNIVERSITY CIRCULARS

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Tuesday, Sept. 18 — Saturday, Sept. 22.	**Examinations for Matriculation.**
Tuesday, September 25.	**Instructions Resumed.**
Friday, June 7.	**Next Term Closes.**

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II. American Chemical Journal.
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III. American Journal of Philology.
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C. S. PEIRCE, Editor. Little, Brown & Co., Boston, Publishers.

VII. Johns Hopkins University Circulars.
Containing reports of scientific and literary work in progress in Baltimore. 4to. $1 per year. Volume I, in cloth, with index, $3.

VIII. Annual Report.
The Seventh Report reviews the work of the University from 1876 to 1882. (September, 1882.)

IX. Annual Register.
Giving the list of officers and students, and stating the regulations, etc., of the University. *Published at the close of the Academic Year.*

X. The Journal of Physiology.
Edited by PROFESSOR MICHAEL FOSTER of Cambridge, Eng., is published with the aid of the Johns Hopkins University. Volume IV. in progress. 8vo. $5 per volume.

The *University Circulars*, *Annual Report*, and *Annual Register* will be sent by mail for one dollar per annum.

University Circular, No. 24, containing announcements of the courses offered for the next academic year, and a Special Circular relating to College Courses will be sent on application;

SCIENTIFIC NOTES

On the work of Members of this University in Mathematics, Physics, Chemistry, Biology, Ancient and Modern Languages, History, Political Science, Psychology, Ethics, and Logic.

NOTES IN PHILOLOGY.

Symmetry in Pindar, by B. L. GILDERSLEEVE.

[Abstract of a paper read at the meeting of the University Philological Association, April 6, 1883].

It is impossible for any one that studies Greek literary art not to count on symmetry. The tendency to balance, to parallelism is universal. In Greek the tendency is a law.

It is needless to enlarge on this. The law of correspondence—measure answering to measure—is fundamental and has been applied to every sphere of Greek art, pictorial, plastic, literary, not without overstraining, yet not without great profit. In music as in architecture it is unquestioned. Even frivolous Offenbach has said: "Music is an algebra." Poetry like music is made up of equations.

In Pindar the symmetry of form is evident. The odes are composed either of corresponding strophes or of corresponding triads (strophe, antistrophe, and epode). But this is not enough. There must be within each strophe, each epode, another balance, another correspondence, another symmetry. Westphal first distinctly postulated this correspondence and opened the way for the establishment of it, but like other bold and brilliant originators, he wearied of his own work, renounced his own principles. Perhaps he did not like his following. Heinrich Schmidt began his metrical and rhythmical studies as a worker on the lines laid down by Westphal, although he differs from his forerunner at every turn, and in the last few weeks Moriz Schmidt, well known as a Pindaric scholar, far from being satisfied with the results of his predecessors, has set up his schemes in opposition to Westphal's and Heinrich Schmidt's.

A sample of the divergencies may be given. In the epode of O. 6 Rossbach-Westphal saw three mesodic periods with an epodikon:

I. 3, 2, 3. II. 4 4 2, 4 4. III. 4 3, 3 3, 3 3, 4. 4 Epod.

Heinrich Schmidt marks five:

I. 3 2 3. II. 4 4 2. III. 4 4, 4. 3 ἐπ. IV. 3 3 3 3. V. 4 4.

Moriz Schmidt pronounces both wrong and constructs a different scheme:

$$A\ \ 6\ \ 4\ 4\ \ 6 = 20. \quad B\ \ 4\ 4\ 4\ 4\ 4 = 16. \quad A'\ \ 6\ 6\ \ 4\ 4 = 20.$$

It will be observed that the number of bars in Rossbach-Westphal and in H. Schmidt is the same. In Moriz Schmidt, owing to the great range he allows himself in the use of *τονή* and *λεῖμμα*—the power of prolonging and the power of resting—the number is slightly increased. He has fifty-six against fifty three. But the other differences are graver. Still whether we accept the short periods or the long, the recognition of some principle of symmetry cannot be withheld. These choral structures were made not only to balance each other, but also to balance themselves.

So much for symmetry of form. Is there any corresponding symmetry of contents? We find it elsewhere in Greek poetry. We find response of antistrophe to strophe in the drama, not only in form but to a certain degree in sense. Are we to renounce this in Pindar? If we are to listen to the oracles of to-day, yes! Westphal found in Pollux a notice of the Terpandrian *νόμος*, emended it, applied it. What is true in it amounts simply to the old principle of beginning, middle, end. To be sure *ἐπαρχά, μεταρχά, κατατροπά, ὀμφαλός, μετακατατροπά, σφραγίς, ἐξόδιον* have a mystic sound, but the seven parts (Mezger gives eight) are not all found in each ode, and, so far as I can see, the discovery amounts to nothing more than the reännouncement of a requirement as old as art itself. Plato demands of every *λόγος* that it shall be a *ζῷον*. A *ζῷον* ought to have head and foot, and if the *ὀμφαλόψυχοι* of to-day* cannot be content without that Delphic expression, it ought to have an *ὀμφαλός* also. But there is danger of carrying the analogy too far. The trunk of man, for instance, is beautifully symmetrical on the outside, but within the vital organs are packed away with scant regard to symmetry. Heart, lungs, liver, without which the skin would be a dead hide, are not remarkable for the balance of their forms. So it may be said that the inner organism of a Pindaric ode need not correspond to the outer form, and that the five triads of the Third Pythian may be chopped up into seven Terpandrian parts—chopped up, for the knife does not come down on the rhythmical joints. But where shall we find anything like this in Greek literature? The further we penetrate into Greek poetry, the greater reason have we to acknowledge the reign of symmetry. Violation of symmetry, of correspondence, may be referred in every instance either to defective tradition or to designed disturbance. As in Greek architecture, so in Greek poetry, departures from symmetry are not only suffered but enjoined for the sake of a higher symmetrical effect, for the maintenance of the feeling of life. The straight line of mechanics becomes the curved line of art. The entasis of the Doric column, the flexure of the Doric stylobate are familiar illustrations of the law of visual effect. The Greek artist had regard to the position that his work was to occupy, to the angle in which it would present itself to the eye of the beholder. So in Greek poetry we must consider the law of higher symmetry, the principle of artistic unity, the calculated effect on the hearer—and we must remember that we have to do with the hearer, not with the reader. *Στιχομυθία* is well, but when passionate utterance gives two verses the time of one, we must not heedlessly apply the knife because the passage looks out of balance. But these interferences apart, we expect a symmetry in contents corresponding to symmetry in form, and we cannot admit a logical division which shall ruthlessly run across all the lines of the artistic structure. We must seek the symmetry of thought, where the symmetry of the form is revealed, in strophe, in triad. Each strophe has its office, each triad its function, and as it is important that nothing should tempt the eye from its work, an edition of Pindar, with a triad on each page, is almost a necessity to the student who wishes to approach the poet directly. The only concessions that must be made to logical distribution are those that must be made in the same department of art. We must simply allow the strophe and the triad the same play that we allow foot and series in the verse.*

Reduce the Terpandrian *νόμος* to a more simple expression, see in it nothing more than a somewhat bizarre statement of the general principles that manifest themselves in an oration of Isokrates or a dialogue of Plato as well as in an ode of Pindar, and I should not object to become a Terpandrian myself. Certainly I should prefer that result to the acceptance of Dissen's elaborate systematization. In his chapter "De dispositione partium," Dissen has treated at length the arrangement of the elements of the epinikion—the preparatory office of the prooemium and the interweaving of the parts. "With the exception of the very short pieces," he says, "all Pindar's odes have at least two parts besides the prooemium," and Dissen has interested himself in showing how the poet prepares his theme, interposes a myth, and then returns to his theme, and how from the simple arrangement which he represents by *a b a*, the poet advances to *a b a c a*, *a b c b a*, *a b c b d a*, and the crowning glory, *a b c d e d a*.

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*'Ομφαλόψυχοι dicti primum Bogomili; deinde ita appellati per ludibrium a Barlamo Calabro monachi aetatis istius qui se ἡσυχαστάς vocabant, a modo quo preces fundebant, μυοῦντες nempe τὸν αἰσθητὸν ὀφθαλμὸν σὺν ὅλῳ νοΐ ἐν μέσῳ τῆς κοιλίας ἤγουν κατὰ τὸν ὀμφαλόν, etc. DUCANGE.

*See Croiset's chapter on this subject, in his "Pindare." The views I am here presenting I have long entertained, but in this, as in all other matters, I am more desirous of thinking a right thought than a new one. As I have not gone into the question of the relation of strophe to antistrophe and epode, I would add here that J. H. H. Schmidt, in his Metrik (S. 350), has shown that Pindar has paused about twice as often at the end of the strophe as at the end of the antistrophe. The object of this, as Schmidt thinks, is to break up the mechanical balance of strophe and antistrophe, or, as he puts it, $a + (a + b)$ is more common than $a + a + (b)$. This is, of course, a reinforcement of the position taken in this paper.

There is of course an element of truth in these recurrences. There is a cyclical movement in many of the Pindaric odes. The myth is usually belted by the praise of the victor and the victor's home, but it is impossible to accept an elaborately systematic arrangement of the subject within the symmetrical structure of the rhythm and independent of it. Dyads and triads there are in Pindar, but they do not disturb the rhythmical working of the odes; and Dissen often elevates to the rank of an organic part what has been brought in simply as a foil. Everything in Pindar must have a deep significance, an independent value, a special allusion, whereas much is put there for the sake of heightening the effect by contrast.

Dissen has gone through all the odes and reduced them to schemes, for which he claims great simplicity and beauty. Furtwängler has selected a few, and expended on them a great wealth of fancy. It cannot be said of him that he is indifferent to the claims of symmetry. To him the Pindaric odes are so many temples, and he sees ground-plans and elevations, and rows of columns, and groups of figures in the rhythmical structures of Pindar. Most persons will consider Furtwängler's book a waste of fancy and ingenuity, and yet it has not been written all in vain. Temple and ode are both built on a plan, both obey the laws of symmetry, and so one may serve to illustrate the other. But the manifestations are different. The temple is to be developed from the cell, the ode from the rhythm. Regard the ode as a great verse and much of the difficulty in finding symmetry in the Pindaric poems will disappear.

Is it a mere fancy to regard the odes as a great verse? Certainly not. There are trochees and trochees, the ordinary trochee (tribrach) ◡ ◡ ◡ (1 1 1) and the *τροχαῖος σημαντός* ⎵ ⎵ ⎵ (4 4 4). The strong part is to the weak part as 2 : 1 in both cases. And so, if the analysis proved it, I should not object to calling Pindar's triads trochees or chorees, his tetrads dactyls, and his pentads cretics, only that system does not seem to work. But we do notice and shall hope to consider more carefully hereafter a manner of limitation to the length of the Pindaric odes. Take out the Fourth Pythian and no ode made up of strophe, antistrophe, and epode goes beyond a pentad. This has its analogy in the law of limit to the length of series. The iambus and the trochee are limited to eighteen morae (2 × 3 × 3), the dactyl to sixteen (4 × 4), the cretic to twenty-five (5 × 5). That is to say, each typical foot gives the norm for combination according to its own proportion. A dactylic verse when reproducing cretic movement cannot go beyond the square of the cretic. The dactylic pentapody

$$- \smile \smile \overset{8}{|} - \smile \smile \| - \overset{4}{\smile} \smile \| - \smile \smile \overset{8}{|} - \smile \smile$$

is a cretic on a large scale, and the 20 *morae* which compose it fall within the 5 × 5. In like manner, the limitation of the number of Pindar's systems inevitably suggests the principle of a rhythmical proportion in the whole piece, which proportion is dependent on the relation of strophe to epode. But it would be premature to discuss this point now, and, besides, the problem of immediate interest is the distribution of the matter of the ode among the strophes or the triads, as the case may be, and here the analogue of the verse as a rhythmical structure and the verse as a logical unit will aid us. The verse, as a rhythmical structure, is made up of verse-feet; the verse, as a logical unit, is made up of word-feet. The coincidence and the discrepancy of verse-foot and word-foot constitute respectively *diaeresis* and *caesura*, if, indeed, one may be allowed to use this nomenclature, which certainly has its convenience.

Now a verse in which verse-foot and word-foot should coincide throughout as in the famous *sparsis* | *hastis* | *longis* | *campus* | *splendet et* | *horret* of Ennius would lack unity, and a succession of them would be intolerably monotonous. Hence the office of caesura to effect unity by dividing a word between two feet and so to force a more energetic recitation. Diaeresis serves to distribute the masses, caesura to unite them.

Of course where the masses are so large as in the Pindaric odes there is not the same danger of monotony. Each triad might present a complete whole. In fact each strophe, each antistrophe, each epode might be rounded off as a separate element without much offence. But the Greek sense of unity demanded a less mechanical distribution, and the parts of each ode often fit into each other as the parts of an hexameter or a trimeter. The preparation, as Dissen would call it, does not count, nor does the connexion. The body of the thought falls within the limits; that is enough. In studying the Pindaric odes I have often thought of the lines of color used in maps to designate boundaries. The eye is not offended by the excurrence there nor the mind by the excurrence here. Making this allowance then and suffering the sense to bind strophes and triads together while the dominant themes of strophes and triads are distinct, we shall find no insuperable difficulty in establishing simple and easy proportions for most of the Pindaric poems. Problems there will always be, and bold would be the man who should maintain that he had said the last word on such a theme.

Of the forty-four Pindaric odes, seven only are composed in single strophes.

Of these, O. 14 has two, P. 12, four, N. 2, five, P. 6, six, I. 7, seven, N. 9, eleven, N. 4, twelve. 7

Most of them are in triads:

One triad:	O. 4, 11(10), 12; P. 2, ...	4
Three triads:	O. 3, 5; N. 5, 6, 8, 11; I. 2, 4, 5, 6, . . .	10
Four triads:	O. 1, 8, 9, P. 2, 5, 10, 11; N. 1, 3, I. 1, . . .	10
Five triads:	O. 2, 6, 7, 10(11), 13 P. 1, 3, 8, 9, N. 7, 10, I. 3, .	12
Thirteen triads:	P. 4, ...	1
		44

It is evident that the single strophe poems will admit of greater freedom of handling, and I shall take those up after discussing the triadic poems.

One triad is evidently too short for any except slight occasional poems. In O. 4 an exceptional poem, the strophe has chiefly to do with God, the antistrophe chiefly with man, the epode is an illustrative myth. In O. 11 (10) the antithetical structure runs through strophe, antistrophe, and epode, but each member revolves about a separate element of the *ἐπινίκιον*. O. 12 rocks even more than O. 11 (10). Each element is distinct. P. 7 has been considered a fragment, but whether it is a fragment or not, each member has its special office.

Two-triad poems do not occur.* The only two-strophe poem O. 14 is suspicious, and cannot be cited to prove that two triads would give ample room. If we are to have introduction, myth, and conclusion, it would be hard to distribute them properly through two triads. Three triads give a natural division, and so we find that it is used nearly as often as five, though the number five suggests a better proportion logically. Each triad has its dominant theme. O. 5 occupies an exceptional position among the Pindaric poems, but the distribution forms no exception. There is no overlapping in it.

Four triads are used as often as three. There is no mechanical uniformity, but, as we should expect, the introduction would dominate one triad, the myth two, the conclusion one, in most of the odes. This is the type, 1 . 2 . 1. Overlapping is the rule. It is remarkable that in Pindar's earliest piece, P. 10, there is no overlapping, and the student of English versification will be reminded of the early timidity of blank verse. P. 10 then would present us with 1 . 2 . 1, pure and simple. Under $1 \underset{\smile}{.} 2 \underset{\smile}{.} 1$, I would put O. 1, O. 9, N. 3. Under $1 . 2 \underset{\smile}{.} 1$, I would put O. 11.

O. 8, I. 1, might be represented by $1 \underset{\smile}{.} 1 \underset{\smile}{.} 2$, N. 1 by $1 . 1 \underset{\smile}{.} 2$, P. 2 by $1 \underset{\smile}{.} 1$ 1 + 1. I. 3 is open to discussion. P. 5 is $1 \underset{\smile}{+} 1 \underset{\smile}{.} 1 \underset{\smile}{.} 1$.

Five triads might be expected to distribute themselves thus: Introduction = 1, Myth = 3, Conclusion = 1, and this is the arrangement in O. 2, O. 6, O. 7, O. 10 (11), P. 8, N. 10. On the other hand O. 13 (1 + 1 . 2 . 1) and P. 1 (2 . 2 . 1) have a quasi epodic structure, two triads representing strophe, two antistrophe and one the epode. But P. 3 and P. 9 throw the weight of the poem on the myth, which leads, (3 . 1 . 1), while the structure of N. 7 is far from being transparent on any theory.

In the Fourth Pythian we have no less than thirteen triads, and it might seem at first as if the epic mass had crushed the lyric proportion. But when we examine the structure more closely we find that the first three triads form the overture, if I may say so. It is a prelude which gives the *motif* of the piece. These three triads are followed by seven triads with the story of the Argonauts in detail, while the conclusion is prepared and consummated in the last three triads.

Of the strophic poems I have already considered O. 14. In P. 12 we recognize the familiar distribution 1 . 2 . 1. P. 6 is represented by 2 . 2 . 2.

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* See J. H. H. Schmidt, Metrik, s. 349.

[Notes in Philology Continued].

In N. 2 there is a curious iteration of the name of the victor and his family $1 . \underbrace{1 + 1} + \underbrace{1 . 1}$. The twelve strophes of N. 4 divide into 3 . 6 . 3, the eleven of N. 9 into 2 . 7 . 2. The difficult I. 7 with its seven strophes is reserved.

To those who must have sharp figures at any cost, these statements will be disappointing, but the exact symmetry is cared for in the rhythm, the metre. We should be offended by an irregular wall. For the figures that surmount the wall we only claim a general balance.

The Laws of Tone-Color in the English Language, by A. H. TOLMAN.

[Abstract of a paper read at a meeting of the University Philological Association, May 4, 1883].

The primary requirements of artistic language are clearness, conciseness, rhythm, and suggestiveness. Tone color is usually secondary and subordinate. Tone-color is the difference between sounds of the same pitch and intensity. For convenience we speak of the consonant and vowel colors. The proposition is that certain colors naturally express certain allied ideas and emotions. Other colors may express them according to the accepted meanings of the words, but they will lack the force which comes from an inner fitness between the coloring and the idea.

Tone-color has been neglected for two reasons: 1st. It has given rise to unpopular or indefinite theories as to the origin of language, such as Onomatopœia and Laut-metaphor. But Onomatopœia and Laut-metaphor as facts in artistic language may be true, irrespective of the use which Wedgwood, Heyse, and others make of them. 2d. Investigators have not recognized the subordinate character of tone-color.

Vowel Colors. The accented vowel colors form a natural scale. The colors at one end naturally express certain ideas and emotions, and those at the other end the contrasted ideas. The order of the vowels in natural pitch, their physiological order, and the law of onomatopœia, as given by Koch and Wedgwood, all confirm the scale which was given. The laws of correct elocution are such that differences in natural pitch, &c., must give a difference in the natural expressional power of each vowel.

Quotations from Shakspeare and others were given, illustrating the general scale and important specializations. A table was given, showing by per centages the use of the different colors in Poe's poem, The Bells.

Consonant Colors. The natural expressional power of each consonant color, and class of colors, was discussed and illustrated by quotations.

Anastomosis, the joining of words. This must be smooth, unless struggle or difficulty is to be expressed.

Variety of Coloring. The most complete variety possible is rarely called for in artistic language.

Repetition and Similarity of Coloring. Poetry regularly repeats the coloring in some form, as it repeats ideas and the verse-foot. Every color repetition is expressive or non-expressive; that is, it either makes use of the full expressional value of the color, or it is pleasant simply because it is a repetition, and gives a merely sensuous pleasure.

English verse began with alliteration. It has developed also rime, terminal and internal; syzygy; assonance; the repetition of a word in the same connection; the repetition of a word within the line; the repetition of phrases, lines (refrains), and stanzas (choruses). By syzygy and assonance is meant, respectively, the general prevalence in a passage of some consonant or vowel color, or class of colors. Mr. Lanier ridicules assonance; but it is used by the best poets in proper moderation.

7.22 per cent. of the pentameter lines in Love's Labor Lost, repeat an important word within the line; 2.21 per cent., in the Tempest. The other comedies of Shakspeare come between these.

Rime was discussed. Contiguous rimes should have contrasted colors, which interferes with expressive riming where there is a fixed rime-scheme.

Repetitions of colors, and cases of a general similarity of coloring, are less prominent in prose, but are frequent and important.

Introductory Note on the Euthalian Stichometry, by J. RENDEL HARRIS.

[Abstract of a paper read at a meeting of the University Philological Association, April 6, 1883].

The object of this paper was to clear away certain fundamental misconceptions as to the connexion between the στίχοι, which are so often reckoned in MSS. of the New Testament, and a certain Euthalius, a deacon of the Church of Alexandria somewhere about A. D., 458. It was shown that in no sense was Euthalius the author of stichometric divisions, nor did these in the New Testament correspond to sentences.

The importance of the work of Euthalius consists in the fact that he professes to have made *accurate* measurements upon superior MSS. viz., those preserved at Cæsarea in the Library of Pamphilus.

The principal authority for Euthalius is Zacagni, *Collectanea monumentorum veterum ecclesiæ Græcæ*, Rome, 1698, from which a full idea may be gained of the prefaces and prologues introduced by Euthalius and the passages measured.

As an example of the work of Euthalius, we may take the Acts of the Apostles which is divided into 16 lections, to each of which the stichometric subscription is appended. It becomes, therefore, interesting to examine whether these lections correspond to the appended number of verses, upon the supposition of a fixed hexameter στίχος.

M. Graux (Revue de Philologie: April, 1878) seems to have attempted this comparison, but was perplexed to find that the numbers given by Zacagni, from the Vatican MS. Regius Alexandrinus, did not correspond with those supplied by a Madrid MS. Codex Escorial, ϕ - *III* - 6 and apparently dropped the subject.

Comparison is now given, for the Acts of the Apostles, in the following table between the data supplied by Zacagni, and the Madrid MS., and the actual measurement of the text of Westcott and Hort's New Testament into 16-syllabled hexameters.

Lection.	Chapter & Verse.	Cod. Esc.	R. Al.	Syllabic.
1	i.1	40	—	40
2	i.15	30	30	30
3	ii.1	109	109	111
4	iii.1	136	136	148
5	iv.32	100	100	121
6	vi.1	38	220	138
7	vii.1 (ἐγένετο)	92	120	94
8	viii.1	75	95	77
9	ix.32	216	250	210
10	xi.27	288	300	271
11	xv.1	198	200	201
12	xvii.1	164	180	164
13	xix.1	239	240	239
14	xxi.15	298	298	307
15	xxiv.27	168	268	168
16	xxvii.1	198	?	192

Some corrections are then made, and the total stichometry of the Acts of the Apostles discussed. The remarkable agreement between the columns is a sufficient proof that Euthalius measured by the sixteen syllabled hexameter or something very nearly equal to it. The subscriptions, however, in R. Al. are frequently corrupt.

Similar results will shortly be exhibited for the whole New Testament and applied to its textual criticism.

Additional Note on the Euthalian Stichometry, by J. RENDEL HARRIS.

[Abstract of a paper read at a meeting of the University Philological Association, May 4, 1883].

The measurements already tabulated for Westcott and Hort's text show a remarkable agreement with the traditional numbers, but there is almost always an excess on the side of the measured verses, and since it can hardly be maintained that the text of Westcott and Hort is open to the charge of too great expansion from primitive copies, it follows that the difference must be due to abbreviations on the part of Euthalius. Allowing a deduction of one syllable for the abbreviation of *θεός*, *χριστός*, and of two syllables for *ιησοῦς*, *κύριος*, and correcting our previous results, we have

	Traditional.	Measured.
James.	242	237
1 Peter.	236	239
2 Peter.	154	157
1 John.	274	261
2 John.	30	30
3 John.	32	31
Jude.	68	68
Romans.	920	918
1 Corinthians.	870	872
2 Corinthians.	590	598
Galatians.	293	293
Ephesians.	312	313
Philippians.	208	208
Colossians.	208	208
1 Thessalonians.	193	189
2 Thessalonians.	106	106
Hebrews.	703	703
1 Timothy.	230	233
2 Timothy.	172	170
Titus.	97	97
Philemon.	38	40

Closer agreement it would be unreasonable to expect.

Functional Differences of the Past Participle in the Periphrastic Perfects of the Latin, Old and Modern French, by A. M. ELLIOTT.

[Abstract of a paper read at a meeting of the University Philological Association, April 6, 1883].

In this paper it was proposed to characterize the development of the past passive participle in its periphrastic use with *habere* (*avoir*) in the classic Latin, low Latin, old and modern French, down to the formation of the present rule of position.

For the classic Latin the law of agreement is absolute whether the direct object precedes or follows the participle; in the low Latin, the inviolability of this law is encroached upon but the participle still maintains the relation of verbal objective to the object, while in the earliest period of the old French the language goes back to its classic model and constant accord again becomes the only legitimate construction. As the analytic tendencies of the language grow stronger towards the middle French period the correct participial forms are lost sight of, until, finally, the traditions of the mother tongue are entirely broken down, the verb *habere* (*avoir*) has given up its fundamental meaning of "to possess" and, as a simple auxiliary, forms with the participle a single compound notion, a mere verbal locution. In the sixteenth century there arose a controversy among the litterati and grammarians as to the proper principle that underlay the then varying mode of treating the participle. Those who wished to stick to the Latin usage made agreement under all circumstances a binding rule, while their opponents, the supporters of the modern drift of the language, held to the invariability dogma throughout. Out of these two antagonistic schools an eclectic school was formed by each of the former contending parties giving up half of their territory. The variability dogmatists kept participial agreement when the object precedes, the invariability dogmatists held their non-agreement of form when the object follows the participle. It is thus that the burden of the Marot rule, the so-called rule of position, was saddled upon us, from which many of the younger grammarians in France to-day are struggling to free themselves by a return to the invariability doctrine, in conformity with the analytic spirit of the modern language.

The views of Brachet, Darmestetter, and Bastin, respecting participial usages in the transition period from the old to the modern conception of the participle idea were discussed, and their theories shown to be untenable for certain phenomena, while they are insufficient to account for the varied growth of others under similar or identical influences.

On a Plautine Pun, by M. WARREN.

[Abstract of a paper read at a meeting of the University Philological Association, May 4, 1883.]

In Aulularia, v. 49, it was proposed to keep the reading of the manuscripts

Testúdineum istum tíbi ego gradibó gradum

instead of changing it with the editors to *grandibo*. Plautus is fond of puns where there is a difference of quantity in the vowels of the words played upon, as *exŏssatum ōs*, *crŭciatum crūsalum*, *lūdo lŭto*, *mĭttis mītis*, *mālis mălum*, *lĭcet infelīcet* The tendency of *n* to disappear not only before *s*, but also before gutturals and dentals, was noticed and examples cited, e. g. before *d* in *facieda*, *Kaledas*. *Secudus*, *cladestinus*, *quado*, cf. Corssen Vocalismus I, p. 257. The epithet of Mars, *Gradivus*, cannot be derived from *grădior* on account of the difference in quantity, *Grădivus* occurring only four times at the close of an hexameter, while *Grādivus* is found at least fifty times. *Gradivus* probably stands for *Grandivus*. In Cato R. R 141, 2, Mars is invoked, *Utique tu fruges frumenta vineta virgulta grandire beneque evenire sinas*. As from the verb *averruncare* we have *Averruncus*, an averting deity, so from *Grandire*, *Gra(n)divus*, a deity promoting growth. This sense is especially appropriate in Vergil, Aen. III, 35.

This paper appears in full in the *American Journal of Philology*, No. 13, pp. 71-75.

On the Etymology of φίλος, by M. BLOOMFIELD.

[Abstract of a paper read at a meeting of the University Philological Association, April 6, 1883].

No less than six distinct etymologies have been proposed for this word, and none has secured for itself the acceptance of scholars generally. With the exception of Vaniček, who ventures to accept the pronominal derivation of the stem (from *sva-* the reflexive) no larger work ventures to accept any of the proposed etymologies. Fick's Comparative Lexicon and the fifth edition of Curtius's Etymology are silent on the subject. The latest etymology propounded by Osthoff in the Morphologische Untersuchungen, Vol. IV, p. 229, according to which *φίλος* is derived from the preposition *ἐφί* (in *ἐφίορκος*) =sk. abhi, and means 'bei-gehörig, zugethan,' is based upon wide-reaching new theories about Indo-European vocalism which are far from certain.

Thus a suggestion which may secure for the word a Sanskrit equivalent can be made without attacking any well-established explanation. There are two proper names in Sanskrit, *Gobhila* and *Rebhila*, whose first syllable may possibly be the diphthongal stems *go* 'cow' and *re* 'property' (Lat. *rēs*). In that case the remainder of the words, *-bhila*, would be sound for sound the Greek *φιλο-* and *go-bhila* would be 'fond of cattle'; *re bhila*, 'fond of wealth.' *Gobhila* is a name which occurs in the Vedic period and is otherwise totally unexplained.

On Some Points in the Relation of the Norman Dialect to English Pronunciation, by H. C. G. v. JAGEMANN.

[Abstract of a paper read at a meeting of the University Philological Association, May 4, 1883].

In this paper an attempt was made to show that the pronunciation of Romance words in English can be traced back to certain phonetic peculiarities of the Norman dialect. The subject will be treated more fully in a future paper.

[Notes in Philology Continued].

Lyric and Non-lyric in Aristophanes.

I was induced to undertake the metrical study of Aristophanes by the hope of finding some normal proportion between the lyric and non-lyric portions of the different plays. As it was impossible for me, on account of lack of time, to study thoroughly the different systems of Greek Rhythmic and Metric, I based my investigations on the system of J. H. H. Schmidt, with which I was acquainted. The results reached, in the course of the investigation, very soon showed that there was no such normal proportion as had been supposed. yet, owing to some curious phenomena that presented themselves, I continued the metrical study of Aristophanes, and finally prepared the table given below.*

For the explanation of the table the following remarks will suffice: The upper part of the table gives the statistics of the lyric portions, and the lower part those of the non-lyric. The right column of each play indicates the ratios in per cent. of the metrical length of the different rhythmical portions of the play to the metrical length of the whole play. The left column gives the number of bars of the different rhythmical portions, measured according to the standard of the Iambic bar of three morae. The prose column was added for the sake of completeness, and, for convenience' sake, was placed at the bottom of the table.

What, perhaps, on inspection of the table, would surprise us most, is the comparatively very low per cent. of lyric in the Clouds. This, I think, may be safely attributed to the bad tradition of the Clouds, and it may be accounted for by the loss of a considerable lyric portion of the play. The loss of a choral song before line 889, which is supposed by almost all editors of Aristophanes to have taken place, is thus put beyond the shadow of a doubt, and the loss of another after line 1104, suspected by some to have taken place, becomes exceedingly probable.

In the Acharnians, Aristophanes exhibits a kind of Aeschylean vigor. The lyric element is very large. The Equites shows a considerable decrease in this respect. The dramatic element, however, constitutes the chief excellence of this play. It is more consistent in plot than any other of Aristophanes' comedies. In the Aves, there is only 14.5 per cent. of lyric. This is due partly to the great length of the play, and partly to the fact that deficiency in quantity is made up by variety and quality. The large proportion of lyric in the Lysistrata and the Thesmophoriazusae arises from the number of vaudeville songs in these plays. The Ranae is the piece of Aristophanes' second youth. The maximum (21 per cent.) of lyric is reached in this play. The two remaining comedies, the Ecclesiazusae and the Plutus, show a great fall in the proportion of the lyric element. The reason is evident. We have here the transition from Old Comedy to Middle Comedy.

C. W. E. Miller.

As a chance word of mine led to Mr. Miller's very laborious investigation, I will add that while the results do not present an ample reward for the trouble taken, still they give us a surer grasp of what was already known, and I have caused the tables to be reproduced, as they may be of service hereafter. It is not likely that Schmidt's analysis will be accepted as final, but, after all, the proportions would not have varied essentially on any reasonable basis of calculation. The modest inferences drawn by Mr. Miller are in accord with the current characterization of the various pieces. Aristophanes makes a vast stride in his art from the Acharnians to the Knights. The cretics are overdone in the former; in the Knights there is a reaction. The two elements, the parodic and the political, mirror themselves in the varying proportions, and we can see clearly that the iambico-trochaic verse is the ground form of comic lyric, going over into cretic in the strongly political plays. The Thesmophoriazusae and the Ecclesiazusae have no cretics, the Nubes practically none, and their range is philosophic and artistic mainly. Logaoedic is a style common to tragedy and comedy; the other forms, dochmiac, dactyl, dactylo-epitrite, Ionic (proper) are really parodic.

B. L. G.

* METRES.	ACHAR.		EQUITES.		NUBES.		VESPAE.		PAX.		AVES.		LYSISTR.		THESM.		RANAE.		ECCLES.		PLUTUS.		TOTAL.	
	Bars.	%	Bars.	%	Bars.	%	Bars.	%	Bars.	%	Bars.	%	Bars.	%	Bars.	%	Bars.	%	Bars.	%	Bars.	%	Bars.	%
Trochaic	152	2.067	136	1.484	47	.471	505	4.906	190	2.319	419	3.823	689	8.492	326	4.554	684	7.387	153	2.021	......	......	3301	3.443
Iambic	464	6.309	374	4.083	226	2.265	316	3.070	208	2.539	274	2.500	203	2.502	319	4.456	374	4.038	251	3.316	196	2.504	3205	3.343
Logaoedic	64	.870	416	4.541	313	3.138	354	3.439	204	2.490	408	3.723	200	2.465	401	5.602	231	2.495	303	4.003	......	......	2894	3.019
Ionic	......	......	......	......	......	......	124	1.204	......	......	12	.109	......	......	......	......	120	1.296	......	......	......	......	256	.267
Dactylic	13⅓	.181	21⅓	.233	165⅓	1.657	......	......	......	......	85⅓	.779	......	......	......	......	430⅔	4.651	......	......	......	......	716	.747
Dact. Ep.	......	......	......	......	......	......	......	......	165⅓	2.018	......	......	......	......	......	......	......	......	......	......	......	......	165⅓	.172
Spondaic	......	......	......	......	......	......	......	......	......	......	109⅓	.994	......	......	......	......	......	......	......	......	......	......	109⅓	.114
Anapaestic	......	......	......	......	18⅔	.187	58⅔	.570	......	......	117⅓	1.074	37⅓	.460	......	......	74⅔	.806	......	......	......	......	306⅔	.320
Cretic	473⅓	6.436	123⅓	1.346	3⅓	.033	160	1.554	185	2.258	110	1.004	203⅓	2.506	......	......	31⅔	.342	......	......	......	......	1290	1.345
Bacchic	3⅓	.045	......	......	3⅓	.033	6⅔	.064	......	......	......	......	5	.062	13⅓	.186	......	......	......	......	......	......	31⅔	.032
Dochmiac	85⅓	1.160	......	......	......	......	32	.311	......	......	53⅓	.486	......	......	26⅔	.372	......	......	......	......	16	.204	213⅓	.222
Total Lyric	1255⅓	17.070	1070⅔	11.688	776⅔	7.785	1556⅓	15.121	952⅓	11.625	1588⅓	14.494	1337⅔	16.488	1086	15.172	1946	21.016	707	9.341	212	2.708	12488⅓	13.027
Trochaic Dim.	......	......	76	.830	......	......	......	......	90	1.098	52	.474	......	......	......	......	......	......	40	.528	......	......	258	.269
Trochaic Trim.	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	6	.079	......	......	6	.006
Tr. Tetrameter	560	7.615	960	10.480	448	4.490	1064	10.338	1168	14.258	1248	11.388	376	4.634	240	3.353	320	3.456	80	1.057	......	......	6464	6.743
Sync. Tr. Tetr.	......	......	......	......	......	......	......	......	......	......	......	......	176	2.169	......	......	......	......	......	......	......	......	176	.183
Tr. Tripody	6	.081	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	6	.006
Tr. Tetrapody	16	.217	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	16	.017
Tr. Hexapody	......	......	......	......	......	......	......	......	......	......	......	......	6	.074	......	......	......	......	......	......	......	......	6	.006
Iamb. Monom	16	.217	2	.022	8	.080	2	.019	2	.024	4	.036	2	.025	......	......	......	......	2	.026	......	......	38	.040
Iamb. Dim	12	.163	4	.043	116	1.163	......	......	8	.097	16	.146	16	.197	......	......	84	.907	......	......	......	......	256	.267
I. Trimeter	4950	67.310	4122	45.000	4566	45.768	4494	43.663	4164	50.831	5538	50.537	4266	52.582	4548	63.537	5040	54.431	5346	70.636	6018	76.884	53052	55.344
I. Tetram	48	.652	1096	11.965	1056	10.585	144	1.399	96	1.172	......	......	552	6.804	360	5.029	536	5.788	56	.740	296	3.781	4240	4.423
Sync. I. Tetr.	......	......	......	......	......	......	200	1.943	......	......	......	......	16	.197	......	......	......	......	......	......	......	......	216	.225
I. Monopody	......	......	......	......	1	.010	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	.001
I. Tetrapody	8	.108	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	8	.008
I. Hexapody	48	.652	......	......	......	......	......	......	6	.073	......	......	......	......	6	.084	36	.389	......	......	......	......	96	.100
Metr. Eupol	......	......	......	......	360	3.608	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	360	.375
Dact. Tetram	......	......	......	......	......	......	......	......	21⅓	.260	......	......	......	......	......	......	......	......	......	......	......	......	21⅓	.022
Dact. Hexam	......	......	392	4.279	......	......	......	......	616	7.519	112	1.022	56	.690	......	......	48	.518	......	......	......	......	1224	1.277
Elegiac	......	......	......	......	......	......	......	......	16	.195	......	......	......	......	......	......	......	......	......	......	......	......	16	.017
Spond. Dim	......	......	......	......	......	......	......	......	2⅔	.032	......	......	......	......	......	......	......	......	......	......	......	......	2⅔	.003
Anapaest. Dim	66⅔	.906	128	1.397	541⅓	5.426	400	3.886	600	7.324	338⅔	3.090	210⅔	2.596	442⅔	6.184	253⅓	2.736	109⅓	1.444	96	1.226	3186⅔	3.324
An. Tetram	352	4.786	1301⅓	14.206	2101⅓	21.063	2432	23.629	416	5.078	1845⅓	16.839	1098⅔	13.542	373⅓	5.215	992	10.713	1216	16.067	1205⅓	15.399	13333⅓	13.909
Prose	16	.217	8	.087	2	.020	......	......	33½	.408	216	1.971	......	......	102	1.425	4	.043	6	.079	......	......	387½	.404
Total Non-Lyric	6098⅔	82.920	8089⅓	88.311	9199⅔	92.215	8736	84.878	7239½	88.374	9370	85.505	6775⅓	83.512	6072	84.828	7313⅓	78.983	6861⅓	90.658	7615⅓	97.291	83370½	86.972
Total Lyric	1255⅓	17.070	1070⅔	11.688	776⅔	7.785	1556⅓	15.121	952⅓	11.625	1588⅓	14.494	1337⅔	16.488	1086	15.172	1946	21.016	707	9.341	212	2.708	12488⅓	13.027
Sum Total	7354	100.000	9160	100.000	9976⅓	100.000	10292⅓	100.000	8191⅚	100.000	10958⅓	100.000	8113	100.000	7158	100.000	9259⅓	100.000	7568⅓	100.000	7827⅓	100.000	95858⅚	100.000

NOTES IN MATHEMATICS.

On Farey Series, by J. J. Sylvester.

[Abstract of a paper read at a meeting of the University Mathematical Society, May 16, 1883].

The ordinary Farey Series is a succession of proper vulgar fractions arranged in order of magnitude, whereof the denominator does not exceed a given amount. The theory may be generalized and simplified by considering the terms of each fraction as the coordinates of a node in a "réseau." If a *simple* and *anautotomic* closed boundary drawn on a tesselation be called a scroll, and any node within it be assumed as origin, a radius of indefinite length rotating about that point as centre, will pass through a series of nearest nodes to it in succession, all lying within the scroll — and the coupled coordinates to those successive points, say (p, q), (p', q'), ... will form a certain series which in general but not universally will satisfy the equation $pq' - p'q = 1$ or $= -1$ according as the order of magnitude is descending or ascending. The character of the series may be termed Farey if this law is satisfied throughout the entire succession and otherwise Non-Farey. The character obviously can only depend on the form, magnitude, position, and aspect of the scroll and the position of the assumed centre. The author of the paper showed that the position of the centre was indifferent except that it must be taken at some node within the scroll, and that the scroll might undergo uniform expansion and contraction about any internal node (and consequently also translation along any line of nodes) without change of character. Application of these principles was made to a triangular or rectangular scroll (including Mr. Glaisher's extension of the theory of ordinary Farey Series to a two-fold constant limit), to the case potentially indicated by Dirichlet where the scroll is formed by two asymptotes to, and the branch of a hyperbola, and two other cases: the theory is deduced without the use of continued fractions or indeterminate linear equations or any other algebraical process whatever, from the well known fact that all elementary triangles in a reticulation are of equal area and from the not very recondite theorem that a triangle may be divided into 4 equal and similar triangles by straight lines joining the bisections of its three sides; and with the aid of a solid reticulation may be extended to triplets and so on indefinitely. It will be found fully set forth in Note H, interact, part 2, Vol. V, No. 4, *American Journal of Mathematics.*

On the Number of Intersections of Curves Traced on a Scroll of any Order, by W. E. Story.

[Communicated to the Mathematical Society, May 16, 1883].

In a former communication I gave a formula for the number of intersections of two curves of any orders on a ruled quadric. I have applied the same method to cubic scrolls. Curves of any given order traced on a scroll may be classified according to the number of points in which they meet any generator. It is evident that a given curve of order m on a given scroll meets every generator of the same infinite system (excepting perhaps the generators of a certain finite system) in the same number of points, say i. Such a curve I call an m_i. If then (m_i, n_j) denotes the number of intersections of an m_i with an n_j traced on the same scroll of order μ, we have $(m_i, n_j) = mj + ni - \mu ij$, at least if $\mu \leqq 3$. If $\mu = 1$, every curve of order m on the plane is an m_m, and we have $(m_m, n_n) = mn$, as in the formula here given.

On an Expression for Euler's Constant, by F. Franklin.

[Abstract of a paper read at a meeting of the University Mathematical Society, May 16, 1883.

If we denote by $f(n)$ the sum of the reciprocals of the natural numbers from 1 to n inclusive, $\lim\limits_{n=\infty} [f(n) - \log n] = C$, and this may be taken as the definition of C, Euler's constant.

Now if we write $\phi(n) = \frac{1}{1} - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \ldots \pm \frac{1}{n}$, it is easily seen that $f(n) - \phi(n) = f\left[\frac{n}{2}\right]$, the square brackets indicating that the integer part of the number they enclose is to be taken. Hence

$$f(n) = \phi(n) + f\left[\frac{n}{2}\right] = \phi(n) + \phi\left[\frac{n}{2}\right] + f\left[\frac{n}{2^2}\right] = \ldots$$
$$= \phi(n) + \phi\left[\frac{n}{2}\right] + \phi\left[\frac{n}{2^2}\right] + \phi\left[\frac{n}{2^3}\right] + \ldots + 1.$$

In this formula, let n be a power of 2, say 2^m; then we have

$$\begin{aligned} f(2^m) - 1 &= \phi(2) + \phi(2^2) + \phi(2^3) + \phi(2^4) + \ldots + \phi(2^m) \\ &= \log 2 - \left(\frac{1}{3} - \frac{1}{4} + \frac{1}{5} - \ldots\right) \\ &\quad + \log 2 - \left(\frac{1}{5} - \frac{1}{6} + \ldots\right) \\ &\quad + \log 2 - \left(\frac{1}{9} - \frac{1}{10} + \ldots\right) \\ &\quad \cdots\cdots\cdots\cdots \end{aligned}$$
$$= m \log 2 - \left\{\frac{1}{3} - \frac{1}{4} + 2\left(\frac{1}{5} - \frac{1}{6} + \frac{1}{7} - \frac{1}{8}\right) + 3\left(\frac{1}{9} - \frac{1}{10} + \ldots - \frac{1}{16}\right) \ldots + m\left(\frac{1}{2^{m-1}} \ldots - \frac{1}{2^m}\right)\right\}.$$

Hence, transposing the term $m \log 2$, $= \log 2^m$, and making m infinite, we have

$$1 - C = \frac{1}{3} - \frac{1}{4} + 2\left(\frac{1}{5} - \frac{1}{6} + \frac{1}{7} - \frac{1}{8}\right) + 3\left(\frac{1}{9} - \frac{1}{10} + \ldots - \frac{1}{16}\right) + 4\left(\frac{1}{17} \ldots - \frac{1}{32}\right) + \ldots$$

It is easily seen that this may be otherwise written

$$1 - C = \frac{1}{3} + 4\left\{3\left(\frac{1}{5.6.7}\right) + 4\left(\frac{1}{9.10.11} + \frac{1}{13.14.15}\right) + 5\left(\frac{1}{17.18.19} + \ldots + \frac{1}{29.30.31}\right) + \ldots\right\}.$$

A Proof of a Theorem of Jacobi, by Arthur S. Hathaway.

[Abstract of a paper read at a meeting of the University Mathematical Society, April 18, 1883].

Namely, that

$$\begin{aligned} &(1 + \varepsilon x^a)(1 + \varepsilon x^{a+h}) \ldots \\ \times\, &(1 + \varepsilon x^b)(1 + \varepsilon x^{b+h}) \ldots \\ \times\, &(1 - x^h)(1 - x^{2h}) \ldots = \sum_{-\infty}^{+\infty} \varepsilon^\delta . x^{\frac{a+b}{2}\delta^2 + \frac{a-b}{2}\delta}, \end{aligned}$$

where $\varepsilon^2 = 1$, $h = a + b$, a, b, being any quantities whatever.

The method is to obtain a general term from the above product by selecting i exponents of x from the first line, j from the second line, and k from the third line, giving $\varepsilon^{i+j}(-1)^k x^{ma+nb}$ by virtue of the relation $h = a + b$. The forms of m and n show that, for all possible selections giving the same m and the same n, i and j are not independent, being connected by the relation $i - j = m - n = \delta$ suppose. Then again, since $\varepsilon^2 = 1$, $\varepsilon^{i+j} = \varepsilon^{i-j} = \varepsilon^\delta$; so that the selections divide themselves into those giving positive terms (k even) and those giving negative terms (k odd), which, it is easy to show by correspondences, cancel each other except when a certain relation exists between m and n, viz., $m = \frac{\delta.\delta + 1.}{2}$, when there is but one selection giving a positive term. This is the theorem in question, as we see by making the substitutions $m = \frac{\delta.\delta + 1.}{2}$, $n = m - \delta = \frac{\delta.\delta - 1.}{2}$. The correspondences are these: The partition of m is composed of i unrepeated integers, j unrepeated integers, k unrepeated integers, the first two sets of which may be converted into an indefinite partition with $\frac{\delta.\delta + 1.}{2}$ less units of content [form the arms of elbows of a graph out of the integers in the two sets, least integer corresponding to least integer, until one set is exhausted, the remaining integers of the inexhausted set which have no correspondents being successively reduced by 1, 2, ... δ or 0, 1, 2, ... $-\delta - 1$, the total of which

[Notes in Mathematics, Continued].

reduction is $\frac{\delta.\delta+1.}{2}$]. In other words a (1 : 1) correspondence exists between an i, j, k partition of m and a partition of $m-\frac{\delta.\delta+1.}{2}$ consisting of an indefinite partition on one hand, and a k partition on the other. Such a bipartition is itself an indefinite partition, and conversely, an indefinite partition of $m-\frac{\delta.\delta+1.}{2}$ involving θ different integers gives rise to $(1+1)^\theta$ such bipartitions [obtained by placing successively zero, one, two, etc., unequal integers upon the k side] giving rise to as many even as odd values of k except when $\theta=0$ or $m-\frac{\delta.\delta+1.}{2}=0$, when there is but one such bipartition [0;] Q. E D. The connection between this theorem and the theorem respecting a bipartition composed of unrepeated odd numbers, the number of parts in the two having a constant difference δ, is at once seen by considering that an i, j partition is obtained from a parallel bipartition composed of odd numbers by taking the greater half of each integer in one partition and the lesser half in the other.

A Note on Conic Sections, by O. H. MITCHELL.

[Abstract of a paper read at a meeting of the University Mathematical Society, March 21, 1883].

The following elementary method of showing the quadruplex nature of the focus, directrix, and eccentricity of a conic seems not to be found in the text-books. Let $x\lambda+y\mu-p=0$ be the equation of the directrix ($\lambda=\cos a$, $\mu=\sin a$), and let (x', y') be the focus. Then comparing

$$(x-x')^2+(y-y')^2=e^2(x\lambda+y\mu-p)^2$$

with the general equation $ax^2+2hxy+\text{etc.}=0$, we get the five equations,

$$\frac{1-e^2\lambda^2}{k}=\frac{a}{c},\quad \frac{-e^2\lambda\mu}{k}=\frac{h}{c},\quad \frac{1-e^2\mu^2}{k}=\frac{b}{c},$$

$$\frac{e^2p\lambda-x'}{k}=\frac{g}{c},\quad \frac{e^2p\mu-y'}{k}=\frac{f}{c},$$

where $k=x'^2+y'^2-e^2p^2$. Writing $s=a+b$, $d=a-b$,

$$R=\pm\sqrt{d^2+4h^2}=\pm\sqrt{s^2+4(h^2-ab)},$$

$\Delta=$ the discriminant, and $\theta=$ the sign of $-Rh$, the following values of $e^2, \lambda, \mu, p, x', y'$, are easily obtained:

$$e^2=\frac{2R}{R+s},\qquad \lambda=\theta\sqrt{\frac{R-d}{2R}},\qquad \mu=+\sqrt{\frac{R+d}{2R}},$$

$$p=\frac{f^2+g^2-\frac{1}{2}c(R+s)}{R(f\mu+g\lambda)\pm\sqrt{-R\Delta}}=\frac{2f\mu+2g\lambda}{R-s}\pm\sqrt{\frac{-4\Delta}{R(R-s)^2}}=p'\pm p'', \text{ say,}$$

$$x'=e^2\left(p\lambda-\frac{g}{R}\right),\qquad y'=e^2\left(p\mu-\frac{f}{R}\right).$$

For each value of R there are thus one value of e^2, one (real) value of the angle a, and two values of p. There are thus four directrices, two entirely real, parallel to each other, the other two with a real direction parallel to each other and perpendicular to the first pair, but at an imaginary distance from the center. To each directrix corresponds one focus and one value of e^2. When $\Delta=0$ the directrices are all real, the members of each pair become coincident, and the four foci are seen to be coincident with the intersection of the directrices.

For the parabola the second form of the value of p is indeterminate, but the first is not.

In the ellipse two of the four values of e are imaginary. When the ellipse is real ($s\Delta<0$), the imaginary eccentricity corresponds to the imaginary directrices and foci; when the ellipse is imaginary ($s\Delta>0$), the imaginary eccentricity corresponds to the real directrices and foci, and the real eccentricity to the imaginary directrices and foci.

The equations of the directrices being found to be of the form

$$x\lambda+y\mu=p'\pm p'',$$

it follows that $x\lambda+y\mu=p'$ are the equations of the axes (λ and μ having two values each), *i. e.*,

$$\theta\sqrt{\frac{R-d}{2R}}\left(x-\frac{2g}{R-s}\right)+\sqrt{\frac{R+d}{2R}}\left(y-\frac{2f}{R-s}\right)=0.$$

Putting now $R'=+\sqrt{d^2+4h^2}$, and substituting both values of R in succession, we get

$$\left\{\begin{aligned}\frac{-2h}{d+R'}\left(x+\frac{2g}{s-R'}\right)+\left(y+\frac{2f}{s-R'}\right)&=0,\\ \left(x+\frac{2g}{s+R'}\right)+\left(y+\frac{2f}{s+R'}\right)\frac{2h}{d+R'}&=0,\end{aligned}\right.$$

as the equations of the axes when $d=+$, and similar equations when d is negative. If $\Delta=+$, the first equation gives the transverse axis; if $\Delta=-$, it is given by the second equation. For when Δ is positive, the negative value of R gives the real directrices, and the second equation (which contains the negative value of R) gives the axis parallel to the real directrices, *i. e.*, the conjugate axis, and *vice versa*.

Other well-known results easily follow from these formulae. Thus, if (x_0, y_0) be the centre, we have

$$x_0=e^2\left(p'\lambda-\frac{g}{R}\right)=\frac{bg-hf}{h^2-ab},$$

$$y_0=e^2\left(p'\mu-\frac{f}{R}\right)=\frac{af-hg}{h^2-ab}.$$

$$\text{Directrix to center}=p''=\sqrt{\frac{-4\Delta}{R(R-s)^2}}.$$

$$\text{Semi-axes}=ep''=\sqrt{\frac{-2\Delta}{(R-s)(h^2-ab)}}.$$

$$\text{Focus to center}=e^2p''=\sqrt{\frac{-R\Delta}{(h^2-ab)^2}}.$$

$$\text{Semi-parameter}=e(p''-e^2p'')=\sqrt{\frac{-8\Delta}{(R+s)^3}}.$$

The system of five equations in the six quantities $e, \lambda, \mu, p, x', y'$, taken with the sixth equation $\lambda^2+\mu^2=1$, has 2048 solutions. That is, algebraically speaking, a conic has 2048 each of directrices, foci, and eccentricities. The process of elimination yields only eight distinct solutions. Since the process consists only of addition and multiplication of the equations, it follows that the remaining solutions are either repetitions of these eight, or are infinite. An examination of the equations shows that they can not have infinite solutions. Therefore the remaining 2040 solutions are merely repetitions of the eight obtained.

A Note on Binodal Quartics, by E. W. DAVIS.

[Abstract of a paper read at a meeting of the University Mathematical Society, April 18, 1883].

Putting the equation of the curve in the form

$$x^2y^2+z^2(ax^2+by^2+cz^2+2fyz+2gzx+2hxy)=0,$$

the tangents from the node (xz) are given by

$$ax^4+2gx^3z+(c+ab-h^2)x^2z^2+2(bg-hf)xz^3+(bc-f^2)z^4=0,$$

or say by

$$x-\alpha z\,.\,x-\beta z\,.\,x-\gamma z\,.\,x-\delta z=0,$$

while those from the node (yz) are given by

$$by^4+2fy^3z+(c+ab-h^2)y^2z^2+2(af-hg)yz^3+(ac-g^2)z^4=0,$$

or

$$y-\alpha'z\,.\,y-\beta'z\,.\,y-\gamma'z\,.\,y-\delta'z=0.$$

Let now

$$s_1=\Sigma\alpha,\qquad s_2=\Sigma\alpha\beta,\qquad s_3=\Sigma\alpha\beta\gamma,\qquad s_4=\alpha\beta\gamma\delta,$$

while s'_1, s'_2, s'_3, s'_4, are the corresponding functions of $\alpha', \beta', \gamma', \delta'$.

We readily find

$$a=-\frac{4}{s_2}M,\qquad b=-\frac{4}{s'_2}M,\qquad f=2\frac{s'_1}{s'_2}M,\qquad g=2\frac{s_1}{s_2}M,$$

where

$$M=\frac{s_2^2s'_4-s'^2_2s_4}{s_1^2s'_2-s'^2_1s_2},$$

and then

$$c=\frac{s_1^2s'^2_2s_4-s'^2_1s_2^2s'_4}{s_2s'_2(s_1^2s'_2-s'^2_1s_2)},\quad h=-\frac{s_2s'_3}{s_1s'_2}+4\frac{s'_1}{s_1s'_2}M=-\frac{s'_2s_3}{s'_1s_2}+4\frac{s_1}{s'_1s_2}M,$$

together with the relations

$$\frac{s_1s_3-4s_4}{s_2^2}=\frac{s'_1s'_3-4s'_4}{s'^2_2}$$

and

$$\frac{s_1s_2s_3-s_1^2s_4-s_3^2}{s_2^3}=\frac{s'_2s'_2s'_3-s'^2_1s'_4-s'^2_3}{s'^3_2}.$$

A Note on the Strophoids, by Edward Barnes.

[Abstract of a paper read at a meeting of the University Mathematical Society, March 21, 1883].

Prof. W. W. Johnson has defined the strophoid (*Am. Jour. of Math., Vol. III*) as the locus of the intersection of two straight lines revolving about two fixed points in a plane.

Considering one of these curves as generated by a moving point and applying quaternion methods, the equation reveals some interesting peculiarities of this class of curves.

Let the fixed points be A and B.

Let m and n be any two commensurable numbers, and ω a constant angular velocity such that $n\omega$ is the angular velocity about B and $m\omega$ that about A.

At the time, $t=0$, suppose the line revolving about A to pass through B, and the line through B to make an angle θ with AB.

Let P be the variable point of intersection.

Then, if $AP=\rho$, $AB=a$ ($Ta=1$ for convenience) and i be a vector perpendicular to the plane of revolution,

$$\rho = a + \frac{\sin m\omega t}{\sin(n\omega t+\theta-m\omega t)}\, i^{\frac{2}{\pi}(n\omega t+\theta)}\, a,$$

both lines revolving in the positive direction.

Or, by expanding $i^{\frac{2}{\pi}(n\omega t+\theta)} a$ and writing n for $n\omega t$, m for $m\omega t$,

$$\rho = \frac{\sin(n+\theta)\cos m}{\sin(n-m+\theta)}\, a + \frac{\sin m \sin(n+\theta)}{\sin(n-m+\theta)}\, ia,$$

or, $$\rho = \frac{\tan(n+\theta)}{\tan(n+\theta)-\tan m}\, a + \frac{\tan m \tan(n+\theta)}{\tan(n+\theta)-\tan m}\, ia.$$

The direction of the tangent at any point is

$$\dot\rho = \frac{m\sin(n+\theta)\cos(n+\theta) - n\sin m\cos m}{\sin^2(n-m+\theta)}\, a + \frac{m\sin^2(n+\theta) - n\sin^2 m}{\sin^2(n-m+\theta)}\, ia.$$

These equations give an n-tuple point at A, an m-tuple point at B, (n, m) tangents at (A, B) dividing the space into (n, m) equal parts, and $n-m$ asymptotes similarly related.

If the line through either A or B revolves in the negative direction, we have only to change the sign of m or n respectively in the above results.

To find the point C where the asymptotes cut the line a, draw a vector w through A perpendicular to ρ and meeting $\dot\rho$. Then

$$w = \rho + x\dot\rho.$$

when x is determined by the relation

$$Sw\rho = 0 = \rho^2 + xS\rho\dot\rho.$$

When $\dot\rho$ becomes an asymptote we have

$$AC = -\frac{m}{n-m}\, a,$$

and since this is independent of t, all asymptotes cut a at C.

For points of inflection we have $\tan\psi$ a maximum; where ψ is the angle between $\dot\rho$ and a, and $\tan\psi$ is the coefficient of ia divided by the coefficient of a in the value of $\dot\rho$, whence $\frac{d\tan\psi}{dt}=0$ gives

$$(\tan m - \tan(n+\theta))(m\tan(n+\theta) - n\tan m) = 0.$$

The first factor gives the infinite points.

The second factor substituted in the value of ρ gives

$$\rho = \frac{n}{n-m}\, a + \frac{n\tan m}{n-m}\, ia,$$

which shows $n-m$ points of inflection situated on a line perpendicular to a through a point D, such that $AD = \frac{n}{n-m}\, a.$

The expressions for AC and AD show that C and D lie outside of A and B respectively when the lines revolve in the same direction, while both lie between A and B when the lines revolve in opposite directions.

For length of arc,

$$S = \int T\dot\rho\, dt$$

$$= \int \frac{\sqrt{m^2\sin^2(n+\theta) + n^2\sin^2 m - 2mn\sin m\sin(n+\theta)\cos(n-m+\theta)}}{\sin^2(n-m+\theta)}\, dt.$$

If we produce AP to A' and BP to B', where $PA' = mT\rho$, $PB' = nT\overline{BP}$, and call $A'B' = L$, we have

$$S = \int \frac{L}{\sin(n-m+\theta)}\, dt.$$

For the area swept by the vector ρ,

$$\frac{1}{2}\int TV\rho\dot\rho\, dt = \frac{m}{2}\int \frac{\sin(n+\theta)}{\sin(n-m+\theta)}\, dt.$$

Some Notes on the Numbers of Bernouilli and Euler, by G. S. Ely.

[Abstract of a paper in the *American Journal of Mathematics, Vol. V, No. 4*].

The article contains first formulae for the expansion of the n-th powers of the trigonometrical functions; then the expansion of the p-th power,—p being an odd prime number—of the secant is more especially considered; by means of this expansion it is shown that the residues of the Eulerian numbers, with respect to prime moduli, are periodic: as for example, that the numbers end alternately in 1 and 5; and finally that the same law of periodic residues holds with respect to certain composite moduli.

NOTES IN PHYSICS.

On Professor Langley's "Selective Absorption," by C. H. Koyl.

[Abstract of remarks at a meeting of the University Scientific Association, May 2, 1883].

During a series of years, beginning with 1859, Prof. Tyndall carried on experiments which demonstrated the great absorptive power of water, carbonic dioxide, and the vapor of water in the infra-red region of the spectrum, and which also demonstrated the non-absorptive character of these substances in the visible parts. Other investigators have, almost without exception, reached the same conclusions, and it now appears beyond dispute that pure water with its vapor and pure carbonic dioxide deeply absorb the long-wave rays but exercise little influence upon the shorter. The same series of experiments proves also that dry oxygen and dry nitrogen either singly or mixed are almost without effect upon any part of the spectrum.

Our atmosphere is composed principally of oxygen, nitrogen, watery vapor, and carbonic dioxide. It follows then, that when there are not clouds or suspended haze, the sky may be, as far as pure absorption is concerned, almost perfectly transparent to the visible rays of solar energy, but to the longer waves opaque, to a degree dependent upon the amount of dissolved aqueous vapor.

Until within a short time actual experiments upon the absorption of the earth's atmosphere as a whole have been of little value because of deficient apparatus, but since the invention and application to this work of the bolometer by Prof. Langley we are able to arrive at approximate results. In his late paper he shows that the ratios of energy in different wave-lengths stopped by our atmosphere are not by any means such as we should expect from the laboratory experiments above mentioned, but that if e', e'', e''' represent the amounts of energy transmitted, (e') to our atmosphere, (e'') through it on a clear day with a noon sun, and (e''') with a low sun, the

[Notes in Physics, Continued].

ratios will be about as follows for three representative wave-lengths, in the ultra-violet, in the green, and in the infra-red,

	V.	G.	R.
λ	.375	.500	1.000
ε'	353	1203	309
ε''	112	570	235
ε'''	27	225	167

demonstrating immediately the fact that though some 54 per cent. of long-wave energy is transmitted at low sun, only about 8 per cent. of short-wave radiation reaches us under similar circumstances. The intermediate rays are transmitted in amounts proportional to some direct function of the wave-length. It seems almost certain, from Tyndall's experiments above quoted, that these short waves are not *absorbed* in the ordinary acceptation of the term. What then becomes of them?

In 1869, Tyndall demonstrated that if ordinary light fall upon a cloud of suspended matter in sufficiently great subdivision, the long waves pass through unhindered while the blue are reflected, and from this he deduced an explanation of the color of the sky. In 1880, I published a brief paper experimentally extending these results to ordinary coatings of oxides of the metals, projected upon charcoal by a blow-pipe flame. From these it was shown that an oxide in thin layers might reflect only a beautiful blue; that if the coating naturally absorbed blue, it reflected in preponderance in thin layers the next longer wave-length; and that, in fact, the amount and character of reflection depended upon the size of particles and thickness of layer. No quantitative measurements were made, but from the magnificent character of the blues obtained, I concluded that nearly all the incident light of that wave-length was reflected. Applying this theory to the sky we have an explanation not only of its blue color and of its sunset tints, but also of Prof. Langley's results that through the lower air, full of these floating particles, the rays of shorter wave-length do not penetrate. It is not selective absorption; it is selective reflection.

COMMUNICATIONS TO THE HISTORICAL AND POLITICAL SCIENCE ASSOCIATION.

Spanish Plots in the Southwest, by C. H. Shinn.

[Abstract of a paper read at a meeting of the University Historical and Political Science Association, March 9, 1883].

The region studied was that south of the Ohio and west of the Alleghanies in the period from 1780 to 1803.

The paper was an attempt to describe the intrigues of Spain to disrupt the American Union. The social and political condition of the Southwest at the close of the Revolutionary war was described, and the claims of Spain were defined. The development of discontent in Kentucky and Tennessee was encouraged by Spain's subtle and three-fold policy of (1) annoying restrictions to American citizens as such; (2) generous concessions, contracts, and monopolies to colonists and secret friends; (3) promises that she would help maintain an independent Western Republic. The development and final failure of this secret policy were traced.

The correspondence of Mirò and de Carondelet, successive governors of Louisiana, with their subordinates and co-conspirators on American soil, the nature of their plots and the nearness of their success, were considered. Indian combinations on the frontier of Georgia, the great Yazoo land schemes, Sevier's "State of Frankland," the various important political movements of the time and the motives and character of the leading plotters were examined. Jealousy and lack of confidence were shown to have existed. General Wilkinson's speculation, tobacco syndicate, receipts of Spanish gold, cipher letters to Mirò, and other schemes seem, in the light of all attainable evidence, to have been dangerous and disloyal. His associates and their methods of "creating public sentiment" were described. The general conclusion was that all pensioners of the Spanish government, and many others deserved punishment at that time. The evidence of the Louisiana records and contemporary testimony bear heavily against the adroit Wilkinson.

In 1795, while the Treaty of San Lorenzo el Real was being negotiated (signed October 27), Judge Sebastian met Don Gayoso, a Spanish envoy at New Madrid, and discussed methods of separating the West from the Union. In 1797, Baron Carondelet sent Thos. Power to Lexington, Ky., with a letter to the conspirators, which, in brief, (1) advised his friends in the West to form an independent republic; (2) promised that the troops of the new government should be armed and equipped by Spain, and paid $100,000 in gold; (3) advised about boundaries; (4) promised aid against the Indians; (5) agreed not to interfere with the framing of laws; (6) the envoy declared that Spain did not intend to carry out her treaty obligations. The conspirators found themselves too weak to venture to make these proposals public. Lesser intrigues continued till the purchase of Louisiana in 1803.

The conclusion, after weighing the evidence against the conspirators, is that their plots were more nearly successful than is commonly supposed, though they were neutralized to some extent by British and French machinations during the same period. It is also believed that the region under consideration, at the period named, presents a comparatively untouched field for historical inquiry. Hitherto it has been abandoned to mere annalists. It deserves such literary treatment as Francis Parkman has bestowed upon the French régime in the Northwest.

Immigration, by C. H. Shinn.

[Abstract of a paper read at a meeting of the University Historical and Political Science Association, March 16, 1883].

In this paper were discussed the more important questions connected with the right of the individual to change his dwelling place, and transfer his allegiance from one government to another; also the effect of immigration upon the United States. Three cases of migration were considered: (1) that of a man moving from one county of a State to another county of the same State; (2) that of a removal from one State to another; and (3) that of a removal from one country to another country. The conclusion was that the right of an individual to leave his native land is absolute; but the country to which he offers himself has the right to decide whether he is a desirable citizen. The exercise of this right is among the duties of a government. Complex social and political questions are involved. The evils of over-population, leading to emigration, the effect of great disasters, and other causes transferring population, were discussed. The arrivals of 1881 (669,431) were considered (1) as regards nationality and race; (2) as regards sex and occupation; (3) as regards effect upon the national life. The causes of the preponderance of the German element were analyzed. The occupations, and sections of the country that chiefly absorb unskilled labor; the effect of surroundings on the new-comer; the questions of climate and native vitality; the probably wise limits of immigration were next considered. Attention was drawn to possible changes in industrial or commercial centers, and to the disturbing influence of trades unions. The end of this great migration to the United States is not far off. Renewed colonization, on a large scale, of the world's waste places is everywhere foreshadowed. Recent political events, reports of exploring parties, organization of great commercial companies, all point towards this end.

The Office of Public Prosecutor, by F. J. GOODNOW.

[Abstract of a paper read at a meeting of the University Historical and Political Science Association, May 4, 1883].

The paper began with a discussion of the two chief methods of procedure in criminal investigations, the litigious and the inquisitorial, and of the application of these methods in the systems in vogue in France, England, and Scotland. Especial attention was given to the historical development of the office of public prosecutor in England and in Scotland.

In most of our American commonwealths and in the judicial system of the national government, there is a minor prosecuting officer, who in most cases is called the district attorney, in others the state's attorney, commonwealth's attorney, county solicitor, circuit solicitor, prosecutor of the pleas, deputy attorney-general, or assistant attorney-general. This office was not brought with us from England, as there was none such there at the time of the colonization of America, or even in 1776. The origin and development of the office can be discovered by an examination of the statutes, especially of the older States. In each of these, except Connecticut, there was in 1776 an attorney-general. As the business of his office increased, other attorneys were deputed to perform his duties at times and places at which he could not be present. In Virginia, a law of 1788 provided for the appointment of such deputies by the attorney-general himself. In 1800, it was provided that they should be appointed by the courts respectively, a second step in their development; their duties were still confined to the lower courts. In 1808, the system was extended to the higher courts; in 1867, the office of commonwealth's attorney was made elective.

The course and extent of the development of the office in each of the thirteen original States was described. An account of the tenure and duties of public prosecutors in all the present States was given. The introduction of the office into the judicial system of the national government by the Judiciary Act of 1789 was accounted for; it was undoubtedly borrowed from the State governments, under which it had by this time become partially developed.

Statistics were given to show that under the Scotch system, with an official prosecutor, the number of innocent persons who suffered lengthened imprisonment was, in the average of three years, only one-eighth of all persons detained in jail for trial by the crown counsel, whereas under the (former) English system, the proportion was one-third.

The Income Tax in the United States, by H. W. CALDWELL.

[Abstract of a paper read at a meeting of the University Historical and Political Science Association, May 4, 1883.]

The Act imposing an income tax became a law July 1, 1862, and was not finally repealed until 1872, although, in the meantime, it underwent many modifications. There seems to have been very little opposition to the income tax. Some discussion occurred in Congress on two phases of the bill: whether all incomes should be taxed, or whether small incomes should be exempted; and second, whether the rate should be uniform or progressive. The decision was in favor of an exemption, and all incomes below $600 were not to be taxed. Afterward the exemption was raised to $1,000, and then to $2,000.

The tax was progressive from 1863 to 1867, but from that time until its repeal the rate was uniform. In this respect, the same policy was pursued as obtained in other countries, tending everywhere to a uniform rate. The original policy of progressivity was adopted on account of its support by Charles Sumner, and on the authority of the French economist, M. Jean Baptiste Say, who argues that a tax of ten per cent. on an income of $10,000 will not occasion a greater degree of sacrifice than a less rate on smaller incomes, or a higher rate on larger incomes. However, there is danger of abuse of this principle, and justice seems to demand that the rate should be uniform.

The first bill imposed a tax of three per cent. on incomes between $600 and $10,000, and five per cent. on incomes over this amount. By the amendment of 1864, the rate on incomes between $600 and $5,000 was five per cent; between $5,000 and $10,000, seven and one-half per cent., and on incomes over $10,000, the rate was ten per cent. Further modifications were made until the last two years, 1870 and 1871, when the rate was two and one-half per cent., and the exemption was $2,000. There does not seem to have been much complaint about the income tax during the first few years of its imposition, but from 1867 numerous charges were made against it.

By an amendment of 1864, each person liable to the tax must make his returns under oath, while under the earlier law no oath was needed, unless demanded by the assessor. Also, by this law, penalties were imposed for neglect or refusal to pay the tax, and for delay in payment. But the most important innovation on the original law was made when every person was allowed to deduct the exemption and pay only on the excess. This principle seems so manifestly just, that we can only wonder that it did not prevail at first. But such was not the case; neither was it retained in the later law of 1870.

In this country, the amount of income was determined by self-assessment, while in Germany the officers make the estimates from apparent resources; but that the former method is the better is shown by a recent trial of the system in Berlin and Hamburg.

The total amount paid in income tax was $376,290,400.67; other sources of internal revenue, $1,259,445,718.06; customs duties, $1,573,460,613.34; total revenue from 1862 to 1872, $3,209,196,732.07.

The above figures show that about eleven per cent. of the taxes collected for the years 1862 to 1871, inclusive, was obtained from the income tax. Now, when this tax was removed, one class was largely relieved from taxation, and the burden was thrown on the people according to their consumption of the taxed articles; but such a tax bears more heavily on the poor and on the middle classes than on the rich, hence an income tax is needed to equalize and supplement other taxes which bear especially on the poor.

By comparing the income tax of 1866 with that of 1867, it is found that 220,000 persons had an income of between $600 and $1,000; and in 1867, 50,888 persons had an income of over $6,000. The cost of collecting was probably not much over two per cent., and certainly not over three, and as the average cost of collecting all taxes was over four per cent., this tax comes nearest Adam Smith's fourth canon of taxation. The usual objections to and arguments for an income tax were brought forward in this country, but no new principles were developed. Finally, under the present system of taxation, the people are bearing burdens almost in proportion to consumption, which violates the first principle of equal taxation, namely, equality of sacrifice.

Taxation in Maryland, by C. M. ARMSTRONG.

[Abstract of a paper read at the meetings of the University Historical and Political Science Association, May 18 and 25, 1883].

The object of Maryland legislation on the subject of taxation seems to have been to require a direct contribution to the public treasury from every person in the State who enjoys any pecuniary revenue, or who owns property of any value. But the law falls far short of accomplishing this purpose. Many persons enjoy large yearly incomes, profits, and earnings, on account of which the State receives nothing directly or indirectly. Ground rents are a clear profit to the owner of the ground, and he pays no tax at all, much less a tax 'according to the revenue he enjoys.' A number of professional men earn $20,000 a year, or even more, and pay no taxes. On the other hand, the owner of leasehold property in Baltimore city is required to pay a tax which often amounts to 25 per cent of his net income. He must own nearly half a million dollars worth of such property in order to derive a net income of $20,000, and on this he will pay nearly $7,000 taxes. Yet, while this is true, the owner of this class of property does not, as is generally supposed, pay the largest tax in proportion to his income. This undesirable distinction is reserved for the holder of State bonds, who, if his bonds bear 6 per cent., pays 25 per cent. of his net income therefrom in taxes. But if they bear only 4½ per cent. interest, his taxes amount to nearly 27 per cent. of the income. And this class of property is strictly assessed at its full value every year, while but little real estate has been assessed since 1876, and this for the most part is assessed at less than its actual value. The case of shares of stock in corporations is much the same as that of State bonds.

An adjustment of the rates of taxation so as to bear most heavily upon those presumably least able to pay is a marked feature of the Maryland system. It is so with the tax on the State bonds. It is true of the traders' license-tax, which amounts to 1⅕ per cent. of the value of the stock where the dealer carries an amount of the value of $1,000, and, as the value of the stock is greater, the per cent. paid in taxes is less, until on a stock of the value of $40,000 it is only ⅜ of 1 per cent. The rates for some other licenses, as wholesale liquor dealers, to keep an ordinary, &c., are arranged upon the same principle.

There is a popular idea that all, or nearly all, of the revenues which come into the State Treasury are derived from the direct tax of 18¾ cents on the hundred dollars ordered by the statute to be levied annually on property and gathered by the collectors. This is an error. The State derived from this source during the fiscal year which ended Sept. 30, 1882, $898,867.18. Of this sum, $789,128.15 were paid through collectors, and $109,739.03 were paid directly to the State Treasurer. The license taxes yielded $517,354.69, and other taxes, as on commissions of executors and administrators, collateral inheritance, &c., $207,970 56. These taxes found their way to the treasury through various channels, some directly from the taxpayer, some through clerks of courts, &c.

The Revised Tariff in its relation to the Economic History of the United States, by Talcott Williams.

[Abstract of a paper read May 30, 1883, before the Seminary of Historical and Political Science.]

The Revised Tariff (Act of March 3. 1883,) bears the same relation to our economic history which the tariff revisions of 1824 and 1828, and accompanying changes, bore to the industrial development which began with the close of the war of 1812. Any discussion of the tariff history of this country necessarily begins with the close of a struggle, in many senses our second war of independence. Before that time, as Benton says, protection had been an incident, since then an object.

Aside from the great change wrought at this period in the trade and commerce of the world by the freedom and peace of the seas, and the consequent growth of shipping, which brought our Atlantic coast nearer Europe than it had ever been before, the United States itself passed through three great changes. Its position as a food-producing nation became clearly defined during the Napoleonic wars. Embargo and war together, its manufactures grew apace under a prohibition of foreign imports for six years, and at the same time they passed through the general change following the introduction of machinery, which substituted factories and powerful manufacturers for the individual, and therefore weak, industries of the domestic loom and forge. Lastly, the revolt of the Spanish American colonies was accompanied by a period of disorder which lessened their commerce and deprived our seaboard of a trade relatively and often absolutely larger early in the century than it has been since, leaving the exchange of food products with Europe the typical characteristic of our commerce.

These changes combined to render the period which began in 1814, and whose tariff legislation commenced with the Act of 1816, a period controlled by conditions still current. The Act of 1816, whose specific terms and careful schedules make it similar in form to the Tariff now in force, many of whose phrases are drawn from it, and differing from any preceding it, was drawn under the influence and direction of manufacturers who found their industries, already in operation, seriously threatened by the large imports of 1815. Here, as elsewhere in our history, protection is obtained after an industry is started.

High duties have rarely been granted in the United States, for protective purposes in specific cases, until some manufacture asked them. Beginning with relatively high duties and an expanded currency, manufactures had, for a brief period, apparent prosperity. Serious depression ensued, and as the administration and effect of a tariff had by this time secured public attention, higher duties were demanded in 1820 and subsequently. Pending these demands, and succeeding a remarkable increase in our production of breadstuffs, there came a period of prosperity, of cheap money, in which a portion of the national debt was funded at a low rate, and a remarkable expansion of means of internal communication took place, the Erie Canal being opened. This succession of events, which closely resembles the period succeeding the tariff legislation of 1867, led to a demand for revision, and when granted by Congress, conflicting opinions resulted in an Act satisfactory neither to protectionists nor free-traders.

From the Presidential election in 1844, closing this period, when Pennsylvania was carried by the cry of "Polk, Dallas, and the tariff of '42," no great Northern State was carried by a tariff issue until 1880, when the Republican party owed its success chiefly to the appeal made, in the closing weeks of the canvass, on this issue. The Congress then elected, had a working protectionist majority in the Senate, while the House was overwhelmingly for protection. When it met, in December, 1881, no doubt existed that if any changes were made in the tariff, they would be in the direction of higher duties. Weeks passed without action, and it was finally decided, in March, to report a bill confining the necessary reductions of revenue to internal taxes. Meanwhile, short crops had raised the price of food fifteen per cent., decreasing enormously the free share of the national income available for the purchase of manufactures after food and rent are paid. But of our adults, at least five-sixths buy their food. The increase in the cost of food decreased the sale of manufactured articles, and raised food imports for 1882, to $47,949,646, exclusive of sugar, spices, tea and coffee. The distress caused by high food and the low sales of manufactures, led to a demand for action on the tariff, which took the shape of a commission for investigation in the recess, and a report at the next session, a proceeding which practically made the general election of 1882 an appeal to the people on this issue. This appeal was taken at the end of a crop year (1881-2), in which there had been grown, as compared with 1880-1, three-fourths as much wheat, two-thirds as much corn, potatoes, and pork, one-seventh less cotton, and everything else in proportion. While the acreage of cereal crops was one-third larger than in 1877, the total cereal crop was smaller, so that 30,000,000 acres were cultivated without increased return. Wool and cotton manufactures were depressed, and the visible supply of print-cloths doubled in six months. Pig iron remained stationary, but steel rails fell from $60 to $45 a ton. Strikes failed to advance prices, and some trades, like rubber, found it wisest to suspend altogether. When the railroad reports came in, it was found that the New York Central had not earned its dividend, the eastward tonnage of the trunk lines for 1882, to September 1, was two-thirds that of 1881, and, as a result of all this, the aggregate fall in stocks from July 1, 1881, to September 1, 1882, was greater than for two years after September, 1873. These causes produced the Revised Tariff, which, like all other tariffs, was a result and not a cause. When Congress met, the blind pressure for a revision had taken shape in an intelligent demand for lower raw materials. The draft Act submitted by the Commission, enabled both Chambers to take up the discussion of a new tariff *pari passu*, and the evidence presented gave a larger body of facts than Congress has ever before had in acting on customs duties. The Act, as finally passed, failed to meet the demand for lower raw material on iron ore, in many other respects it did, and in precision it was a great advance on any previous tariff. From a protectionist stand-point, it was notable for its admission that some industries had had enough of protection and could stand a reduction; it is remarkable in our economic history for the resumption of economic influences in our legislation, interrupted by the demands of slavery for solution, non-sectional votes being cast on a tariff question for the first time since 1828. Its political lesson is the promise and prophecy it carries of additional reductions as inevitable in the near future as in 1883.

NOTES IN BIOLOGY.

On the Relation of Bilateral Symmetry to Function, by E. M. Hartwell.

[Abstract of a paper read at a meeting of the University Scientific Association, May 2, 1883].

The correlation of bilateral symmetry in structure with bilaterally equal functions in the bodies of vertebrates, especially man, was taken as the general topic of this paper.

Attention was called to the clear recognition on the part of the ancients of the disproportionate powers of the two sides of the body. Assyrian, Egyptian, and Greek sculptures for the greater part depict right-handed men; and in some instances the right side of the body is represented as asymmetrical with the left. The speculations of Plato and Aristotle, of Hyrtl, and of Charles Reade, were instanced as types of the various hypotheses advanced to explain right and left-handedness. Observations made by scientists upon the differences in color markings on the two sides of the body, in dogs and horses; upon the inequality of the right and left sides of the skulls of civilized races; on the disproportion, as regards size, the number and depth of convolutions, and the number of motor fibres, found to exist between the right and left sides of the human brain; and upon the differences in the functional powers of the two eyes of a single person, were cited as tending to show that unequal and unbalanced functions accompany asymmetrical organs. It was held that asymmetry, and the inequality of function correlated with it, is to be accounted for as a variation, due to specialization, from the normal type. The ancient views of the office of the brain, based upon the doctrine of animal, vital, and natural spirits, were contrasted with the modern theory of localization of the functions of the brain. based upon the study of its anatomy, physiology, and pathology; and the principal arguments for and against the notion that the brain is a double organ, were outlined.

The main portion of the paper consisted of a preliminary report of a research conducted by the writer at the suggestion of and in conjunction with Dr. G. Stanley Hall. In this investigation, which was still in progress, it had been attempted to determine, in some degree, the nature and extent of the functional differences between the two sides of the body in right and left-handed persons.

The results of the investigation may be stated as follows:

A.—(*a*). If a person sit, with his eyes shut, before a table upon which at an arm's length from him a measuring rod is fastened in a horizontal position, and attempt to make, with his index fingers, exactly equal and simultaneous excursions along the rod from its middle point; that person, if he be right-handed, will generally make wider excursions to the right than to the left; while if he be left-handed, the excess of error will be toward the left. (*b*). The per centage of error increases to a distance of from 80 to 40 c. m. from the middle point of the rod, and then diminishes. (*c*). The movement in the above case is made from the shoulders, the arms and hands being fully extended—but if the movement be from the elbows, or the wrists, or simply with the index fingers, the excess of error subsists in the same sense but not in the same degree. (*d*). Inasmuch as the excess of error is scarcely affected, if, instead of making simultaneously impulsive movements, the attempt be made to make the excursion of the second hand equal to that of the first, immediately the excursion of the first hand is completed; it would seem that a difference in the amount of central innervation for the right and left sides is the chief factor in producing the excess of movement of the stronger side.

B.—(*a*). If the person observed, with his eyes open, stick a pin with one hand into a measuring rod fastened as described under *A*, on the same side of its middle point as the hand that bears the pin, and then attempt with the other hand, even after careful sighting, to measure off an equal distance on the other side of the middle point of the rod, there will be an excess of error to the right if he be right-handed, and *vice versa*. (*b*). The error of the eye in judgments of distance to the right or left of the middle point of the measuring rod is, within the field of direct vision, constant and in the same sense as the error of the hand in simultaneous, impulsive movements. (*c*). The error of the eye is greater in the field of indirect than in the field of direct vision.

C.—If the experiment be made exactly as in the first case described under *A*, with the exception, that impulsive movements be made with the right and left hand alternately leading at an interval of one second or four seconds in advance of the other, then— (*a*). The excess of error is far greater than in the case of simultaneous, impulsive excursions. (*b*). The error is in a sense opposite to that given under *A*. (*c*). The excess of error is greater for the left hand, in right-handed persons, than for the right, and *vice versa:* and this excess for the left is greater when the right leads than when the left leads.

D.—If a person, with his eyes shut and his arms and hands extended, attempt to bring the middle points of the tips of two thimbles, equally weighted, and peculiarly armed for the purpose of securing a graphical record, together by simultaneously impulsive movements, it is found— (*a*). That symmetrical movements are more exactly executed when made in a plane continuous with the median plane of the body, and above and in front of the head, than when made to the right or left of that plane. (*b*). The right hand in such movements in the median line takes a position in advance of and above the left among the right-handed, while the left is similarly advanced above the right in the case of the left-handed.

E.—By using a dynamometer designed to test and record the clenching power of the hand, it was determined that— (*a*). A maximal clenching movement with one hand is weakened if a symmetrical maximal movement be simultaneously made with the other hand; but that a maximal, simultaneous, unsymmetrical movement has no effect. (*b*). Submaximal movements have an effect opposite to those of maximal movements, in that they produce summation and not weakening. The right hand in dexterous persons has more power of interference with the left than the left has with the right; and the reverse is true in case of the left-handed. Fatigue reduces the error of the stronger hand more than the error of the weaker hand.

F.—The reaction time of the stronger side, *i. e.*, the right in the right handed and the left in the left-handed, is longer than the reaction time of the weaker side.

On Ciliated Epithelium in the Human Kidney, a Note by A. H. Tuttle.

[Abstract of a paper read at a meeting of the University Scientific Association, April 4, 1883].

Ciliated epithelium, long known to exist in the renal organs of the lower vertebrates, has recently been detected in the kidneys of several mammals by Klein and others. The fineness of the cilia and the smallness of the lumen of the convoluted tubules in mammals render their demonstration comparatively difficult, and it is essential that material employed for this purpose should be put into hardening fluids while perfectly fresh; a condition in which the human kidney is not usually obtained.

An opportunity recently occurred of examining a number of human kidneys obtained in an unusually fresh condition at post-mortem examinations of smallpox patients. The parenchymatous swelling of the renal tissues occasioned by the disorder enlarging the lumen of the tubules, and rendering the structural elements unusually distinct, the examination of exceedingly thin sections (mounted in glycerine) with a Zeiss one-twelfth homogeneous immersion objective showed plainly the presence of cilia upon the epithelium of portions of the convoluted tubules.

A fuller account will be published in the forthcoming number of "*Studies from the Biological Laboratory*" of this University.

CORRESPONDENCE.

Extracts of Letters to Professor Sylvester, *from* Mr. J. Hammond, of Buckhurst Hill, Essex, England.

March 14, 1883.—. . . As the matter now stands, it seems to me that in order to obtain correct results a generating function for syzygants is required as well as one for covariants. It would not be difficult to write down such a G. F.* for syzygants of degree 5 for any Quantic, but how can all syzygants whose degree is higher than 5 be found? I cannot tell.

What was called the automatic method of tamisage in my letter of January 28, suffers from this perhaps more than the method of the 4th section of your memoir on subinvariants. I give the tamisage by this method for the Cubic, Quartic and Quintic that you may see an example of the work: Multiplying both numerator and denominator of the representative generating function $\frac{1+a^3x^3}{(1-a^4)(1-a^2x^2)(1-ax^3)}$ by $1-a^3x^3$ we have $\frac{1-a^6x^6}{(1-a^4)(1-a^2x^2)(1-ax^3)(1-a^3x^3)}$, which may be called a fully representative form of generating functions, inasmuch as all the ground-forms are represented in the denominator and the only syzygant in the numerator. Similarly the fully representative form for the Quartic is

$$\frac{1-a^6x^{12}}{(1-a^2)(1-a^3)(1-a^2x^4)(1-ax^4)(1-a^3x^6)}.$$

The case of the Quintic is far more complex, but here it may be proved that any ground-source of weight *w* is of lower degree than that ground-syzygant of the same weight whose degree is a maximum; and if the postulate were true any ground-source of weight *w* would be of lower degree than any syzygant of the same weight. We are now led to reject all terms of the numerator of the representative generating function, except those in the first positive block. The remaining terms are

$$1+a^3(x^3+x^5+x^9)+a^4(x^4+x^6)+a^5(x+x^3+x^7)+a^6(x^2+x^4)$$
$$+a^7(x+x^5)+a^8(x^2+x^4)+a^9(x^3+x^5)+a^{10}(x^2+x^4)$$
$$+a^{11}(x+x^3)+a^{12}x^2+a^{13}x+a^{14}x^4+a^{16}x^2+a^{18}.$$

Multiply now both numerator and denominator by $1-a^3x^3$, rejecting negative terms in the numerator; this destroys the terms a^3x^3, a^8x^4, a^9x^5, $a^{10}x^4$, and $a^{14}x^4$, and places an additional factor (3.3) *i. e.* $1-a^3x^3$ in the denominator.

Continuing the process with (3.5), (3.9), (4.4), and (4.6) instead of (3.3) each multiplication will only destroy a simple term in the numerator; and there remains in the numerator

$$1+a^5(x+x^3+x^7)+a^6(x^2+x^4)+a^7(x+x^5)+a^8x^2+a^9x^3+a^{10}x^2$$
$$+a^{11}(x+x^3)+a^{12}x^2+a^{13}x+a^{16}x^2+a^{18}.$$

Continuing the process with (5.1) destroys the terms a^5x, $a^{10}x^2$, $a^{11}x^3$, $a^{12}x^2$, and $a^{16}x^2$.

There is now left in the numerator

$$1+a^5(x^3+x^7)+a^6(x^2+x^4)+a^7(x+x^5)+a^8x^2$$
$$+a^9x^3+a^{11}x+a^{13}x+a^{18}.$$

If the process were now continued by multiplying by (5.3), (5.7), (6.2) . . . . each step would only destroy one term in the numerator and introduce one factor in the denominator, and so the process is at an end.

There is a rather absurd erratum in my note of December 4th, for *representative ground-form* read *representative generating function.*

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*Generating Function.

April 16, 1883.—. . . Every spare moment of my time has been spent in searching for a method of finding the syzygies of Binary Quantics. This method I believe I have found for the Quantic of the infinite order, but I anticipate considerable difficulty in distributing the syzygies among the lower Quantics.

In Vol. XIII. of the London Mathematical Society's Proceedings and in another paper not yet published, I proved that the symmetric functions $\Sigma\alpha^l\beta^m\gamma^n\ldots$ of the roots of $1-\frac{p_1}{x^1}+\frac{p_2}{x^2}-\frac{p_3}{x^3}+\ldots=0$ satisfy the differential equation

$$\frac{d}{dp_1}+p_1\frac{d}{dp_2}+p_2\frac{d}{dp_3}+\ldots=0,$$

provided no unit occurs among the indices l, m, n, etc., *i. e.* such symmetric functions are subinvariants; as I learned from your memoir on subinvariants.

I am afraid that I cannot put the thing before you in a manner at once short and intelligible, but by following up this hint I have obtained the same generating functions as are given in sec. 4 of your memoir for degrees 2, 3, 4 $\left(\text{viz., } \frac{x^2}{1-x^2}, \frac{x^3}{(1-x^2)(1-x^3)}, \frac{x^7}{(1-x^2)(1-x^3)(1-x^4)}\right)$ and passing on to degree 5 found the same results as given in my letter of March 8th. After that I went on to degree 6 which I have not sufficiently studied yet but in which I found several syzygies (none of them so far as I can remember new).

The following simple examples may illustrate my method of working.

Denote $\Sigma\alpha^l\beta^m\gamma^n\ldots$ by $(l, m, n, \ldots)$

Then $(3)(2.2)=(5.2)+(3.2.2)$

$(2)(3.2)=(5.2)+(4.3)+(3.2.2)$

gives a syzygy of deg. 5, wt. 7,

$(3)^2=(6)+(3.3)$

$(2)^3=(6)+(4.2)+(2.2.2)$

gives a syzygy of deg 6, wt. 6.

In these examples numerical multipliers are neglected.

In considering degrees 3 and 4 it is shown that (3.3) and (4.3) are ground-forms. I am now in some difficulty; I cannot arrange the results I have from time to time announced in anything like a connected form, so that I cannot help thinking that my next paper when it comes to be written out will be a sadly disjointed and incoherent affair. I will try once more to put these things in a connected shape, and if I am still unsuccessful will send them as they are "with all their imperfections on their head;" but they will be little better than rough notes.

P. S.—*April* 17.—I have an idea not very clear at present that it will eventually be possible to obtain all the ground-sources of a given degree-weight both in *number and position* and that when this is done to each ground-source will correspond a given partition of the weight not containing a unit. Thus for deg. 3, wt. 9, there will be the two partitions (3.2.2.2) and (3.3.3), the first of which corresponds to the cubic protomorph of wt. 9 and the second corresponds to a cubicovariant of the 7-ic.

If I can only distribute the ground-sources and syzygies properly among their respective Quantics I think there will be no difficulty after that.

Extract of a letter to Professor Sylvester *from* Professor Cayley.

Cambridge, *April* 6, 1883.—It seems to me that in the N. G. F.* there is no possible way of taking account of the syzygies which present themselves in defiance of the fundamental Postulate, but that this can be done with the R. G. F.†—in fact that the R. G. F. is capable, what the N. G. F. is *not*, of telling the whole truth. Take the quintic; in the developed N. G. F. we have a term $4a^8x^4$, and there are in fact of this deg-order 8.4 the four terms b^2g, bm, dj, gh, [$a, b, c \ldots w$ the 23 covariants], and these being in fact asyzygetic, we have in the R. G. F. a term

$$\frac{dj(1-ag^2)\ldots}{1-a.1-b.1-c.1-g.1-q.1-u} \text{ (see 10th Memoir)‡;}$$

but suppose there had been a syzygy between b^2g, bm, dj, gh—and consequently for the deg-order 8.4 a new covariant z; then the term in the R. G. F. might have been written

$$\frac{z(1-ag^2)}{1-a.1-b.1-c.1-g.1-q.1-u},$$

and the new form of the R. G. F. would have put in evidence the 24 covariants $a, b, c \ldots w$ and z. Of course, writing therein $z=a^8x^4$, we should obtain the N. G. F. in its original form, and there would be no longer any trace of the new covariant. It would thus seem that the true question is that of finding the expression of the R. G. F., but to do this we require first to know the number and form of the extra-syzygies. . . .

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* Numerical Generating Function.

† Real Generating Function.

‡ On Quantics.

The Peabody Library Building.

Statements, utterly erroneous and misleading, in regard to the capacity and cost of this library building, have been widely circulated, and I have been repeatedly urged to correct them. In these statements the capacity of the library is put at 160.000 volumes and the cost of storage at $2 per volume. I have gone carefully over the calculations once more, and find the capacity of the main hall for books to be 300,000 volumes, allowing but eight volumes to the running foot on the actual shelving — all that our large volumes will permit. The other rooms in which books are stored will hold, on the same basis of 8 books to the foot of actual shelving, 28,000 volumes, making the capacity of the library 328,000 volumes.

The cost of the fire-proof marble wing containing the library, including shelving and furniture, was $342,000. Seven-fifteenths of this wing, by actual floor measurement, are occupied by art galleries and lecture halls; and must have cost at least one-third of the whole, or $114,000, leaving the actual cost of the library building $228,000, or less than 70 cents per volume for storage instead of $2.

But the capacity of libraries is usually estimated on the basis of 10 books to the *square* foot of shelving instead of 8 books to the *running* foot. This library, on account of its many folios and other large books, averages at present but 8 volumes to the running foot. Allow 10 books to the *running* foot, and the result will be a capacity of 410.000 volumes and a cost of 55 cents a volume for storage; but make the usual count of 10 books to the *square* foot of shelving, and the capacity becomes 500,000 volumes and the cost of storage 45 cents a volume. In regard to the statement that this library is so constructed that it can never be enlarged, it may be said that the lecture halls and art galleries can all be thrown into it, and thus its capacity for books be more than doubled.

After having given many years to the study of library economy and library architecture, after having visited nearly all the great libraries of the world, and examined plans innumerable of both the old and new styles of building, I have been forced to the conviction, that, for any library, like that of a university, where the readers are to have access to the shelves, the central hall with surrounding alcoves is by far the most convenient and the most beautiful of all library structures; and that it can be made as economical as any yet devised which will furnish the same amount of light, air, and general accommodation to readers and attendants. It is the only form of library that admits of fine architectural proportions and decoration; and surely the settings and surroundings of books are as suitable for ornamentation, are as legitimate objects on which to display artistic beauty and taste as title-pages, paper, print, margins, and bindings. A grand hall, filled with the gathered wisdom of ages visibly set in alcoves chastely but richly ornamented, will impress the young student with a respect for books and a sense of their importance which he will never forget, and which no multiplication of "stacks" will ever give. I can but think that the present rage for "stacks" and warehouse packings — fit only for popular circulating libraries — is a temporary mania which must soon pass away. The falling of dirt and the rising of heat through the perforated or grated floors required for light in the warehouse plan of building, and the danger of leakage and drip from glass roofs placed over the books, are fatal objections to their use. Solid floors alone, as this library has shown, will keep the highest alcoves at as low a temperature as the lowest, and that is a fact of the utmost importance in library architecture.

PEABODY INSTITUTE, *May* 11, 1883. N. H. MORISON, *Provost.*

THE DIRECT INFLUENCE OF GRADUAL VARIATIONS OF TEMPERATURE UPON THE RATE OF BEAT OF THE DOG'S HEART.

By H. NEWELL MARTIN, M. A., M. D., D. Sc.

(Abstract reprinted from the Proceedings of the Royal Society of London, No. 223, 1883).

In the investigations described, the method of experiment was such as to completely isolate physiologically the heart of the dog from all the rest of the body of the animal, lungs excepted.

This was accomplished by occluding the right and left carotid and subclavian arteries, the aorta just beyond the origin of the left subclavian, and ligaturing both venæ cavæ and the azygos vein. In consequence the only fraction of the systemic circulation left open was that through the coronary system of the heart; no organ but the heart itself has any blood sent it, except the lungs. Hence the cerebro-spinal nerve-centres and the sympathetic ganglia very soon die, while the heart remains alive, in good working condition, for two hours or more. The right auricle is supplied uniformly with defibrinated calf's blood, conveyed to the superior vena cava from Mariotte flasks. The blood, after traversing the pulmonary circuit, is finally pumped by the left ventricle into a cannula, which is tied into the aorta just beyond the origin of the left subclavian artery. From the distal end of the cannula a wide rubber tube carries the blood to an exit cannula seven or eight feet above the level of the heart. By raising or lowering this exit, and by raising or lowering the level of the Mariotte flasks feeding the heart, arterial and venous pressures could be changed at will, or maintained very nearly constant.

Venous and arterial pressures being kept constant, the temperature of the blood supplied to the heart was gradually changed by raising or lowering the temperature of the water contained in the vessels in which the feeding Mariotte flasks were immersed.

The pulse rate was recorded by a Fick's spring manometer, and arterial pressure by a Marey's mean-pressure mercury manometer, each being connected with the central stump of a carotid artery. Temperatures were read by means of a thermometer tied into the root of the left subclavian, so that its bulb projected into the aortic arch.

Uniform artificial respiration was maintained.

As the result of many experiments, it was found (1) that the isolated dog's heart beats quicker when supplied with warm blood, and slower when cold blood is supplied to it; (2) that the rate of beat depends much more upon the temperature of the blood in the coronary arteries than on its temperature in the right auricle or ventricle; (3) that when defibrinated calf's blood is used to feed the heart that organ cannot be kept alive as long as when defibrinated dog's blood is employed; (4) that no matter how long an experiment lasts the defibrinated blood, circulated again and again through heart and lungs, shows no tendency to clot; hence fibrinogen is not produced in those organs.

The question answered by the first of the above results was the one for whose solution the research was undertaken. The experiments show that, in spite of its highly-developed extrinsic nervous apparatuses, the heart of the mammal does, so far as its rhythm is concerned, in its own nervo-muscular tissues respond to temperature variations within wide limits (42°–27° C.), just as the frog's heart or that of the embryo chick does. To account for the quick pulse of fever, we, therefore, need not look beyond the mammalian heart itself. We require no theoretical assumption of any paralysis of inhibitory, or any excitation of accelerator cardio-extrinsic nerve centres.

The paper of which the foregoing is an abstract has been selected as the "Croonian Lecture" of the Royal Society of London for the present year, and will appear in full in the next volume of The Philosophical Transactions.

THE ECLIPSE OF THE SUN ON MAY 6, 1883.

(Reprinted from *The Times*, London, July 2, 1883).

During the last few days additional information has been received both from the French and American expeditions sent out to observe the eclipse of the sun on the 6th of last May. The more we learn about the results of the expedition the more we see that most excellent work has been done, and, as we surmised in our previous article, new questions have been brought to the front as well as old ones probably settled. Let us deal with some of these *seriatim*. One matter, outside the domain of solar physics, but yet of extreme interest to the astronomical world, is concerned with the possible existence of a planet or planets nearer to the sun than Mercury. Such a planet has been "discovered," two or three times, only to be lost again; its existence has been predicted from general considerations, but yet, strange to say, it has not revealed itself when it has had every opportunity of doing so, for instance in the photographic record of the sun which is now being slowly introduced, at a sufficient number of places on the earth's surface to make the story almost a continuous one. This question was seriously taken in hand at the late eclipse by Dr. Janssen, the head of the French party, by MM. Palisa and Trouvelôt who accompanied him, and by Professor Holden, who was in charge of the American party, in consequence of the enforced absence of Professor Young, to whom the charge had been in the first instance offered.

The result of this combined attack is to show that there was no body near the sun brighter than a star of 5½ magnitude. Professor Holden's conclusion depends upon eye observations. Dr. Janssen's depends upon photographs of the whole region near the sun to a distance of 15 deg. all round it. Such self-confirmatory evidence as this is of the highest value, and must be held, we think, to suggest that the body seen by Watson in 1878 was in all probability a comet, as was, indeed, suggested by the appearance of the comet seen in Egypt last year. Had the comet then observed been less bright than it was, so that the nucleus alone had been visible, the discovery or the confirmation of the existence of an intra-Mercurial planet would in all probability have been announced to the world.

Next in point of view of general interest to this work with regard to the intra-Mercurial planet, we may refer to some observations made by Professor Hastings, which are of very great value taken in conjunction with prior work. In order, however, that the full importance of Professor Hastings's observation may be clearly grasped, it is necessary to go briefly over the history of eclipse work since the year 1869. It was only really in the eclipse of that year that we began to know anything about the corona, and it was only in the eclipse of 1870 that we began to appreciate what a very difficult problem was presented to us by that phenomenon. The then Astronomer Royal and Professor Maedler, to cite some among the eminent authorities writing after the eclipse of 1860, had come to the conclusion that the corona was mainly a non-solar phenomenon. That *part* of it, however, was undoubtedly solar was admitted by all, for the reason that it was seen before and after totality. In the eclipse of 1870 the idea that part of it was really non-solar was enormously strengthened by a comparison of observations made by different astronomers. Its shape seemed to change as the moon swept over it, and this, obviously, if it were true, implied some action of the moon's edge and reflection by something between the observer and the moon. In 1871, when the Government of India and the British Association took steps to have the corona photographed at the same time that it was carefully observed by the naked eye, the strange fact was first clearly indicated that the corona seen by the eye was a perfectly different thing to that recorded on the photographic plates. The explanation given at the time was that the coronal light was much more actinic than ordinary solar light of the same visible intensity, so that in the eye and on the photographic plate two different images were built up by different qualities of light proceeding from different sources. Hence the view was distinctly enunciated that the corona seen during eclipses was a dual phenomenon, partly solar, partly non-solar in its origin, the true solar corona being filamentous with variously-curved streamers, the visible corona being non-filamentous and consisting mainly of radial lines and rifts, extending to different distances from the edge of the moon. Such observations as these show how extremely difficult it was to determine the real limits of the corona by means of any simple analysis of the light from any part of the regions surrounding the sun. When spectroscopic eclipse work began it was imagined that if a part of the circumsolar region, say 1 deg. from the sun, was brought on to the slit of the spectroscope, and a bright line spectrum obtained, here was evidence that the corona extended to 1 deg. from the sun. It was only some time after such observations as this were commenced that it was found that the earth's atmosphere was so flooded with coronal light that even the dark moon itself gave such a record. This fact was most strongly brought home to us in the eclipse of last year, when the coronal spectrum was photographed extending right across the dark moon, and the result obtained in 1871—namely, that the corona was chiefly built up of blue light—was clearly confirmed by the fact that the photographs revealed that the strange, weird, lurid light, so special to eclipses, was really nothing but the reflected blue coronal light in our air.

These things being premised, we can now come to Professor Hastings's observation. He was among the first many years ago to recognize the importance of observing the spectrum of different parts of the sun side by side in the spectroscope, and for this purpose he, as well as others, prepared a special piece of apparatus allowing him to study the chromosphere on two opposite parts of the sun's limb at the same time. This was the instrument he used at Caroline Island this year. What he set himself to do was to carefully watch during the eclipse the apparent height of the corona, as determined by the lengths of the chief line in its spectrum at the two opposite points of the moon's diameter at which totality commenced and finished. Of course, if each line were really due to an actual definite corona of the sun, the position of its extreme summit, and its length would not greatly vary, but if the spectroscope revealed a flash of light, now on one side of the moon and now on the other, produced by some such action as that to which we have referred then it is obvious that the position of the summit of each line would greatly vary, its length varying in equal proportion. The question put to the sun, it will be seen, was of a most definite character, and Professor Hastings found that there was immense variation in the lengths of the lines. At the beginning of totality the 1474 line had a length of 12′ on the east side, while on the west it was seen short and faint. During the progress of the eclipse this difference in length disappeared, but was reversed at the end of totality, the change being greater than that which would result from the moon's motion alone On the strength of this variation, Professor Hastings gives out the view that this paying out of light, first on one side of the dark moon and then on the other, is an effect of diffraction at the moon's edge. He, however, goes further than this, and, as we gather from his telegram to Professor Young, proposes to abolish the external corona altogether from our text-books. Here astronomers, while acknowledging the ingenuity which suggested the above observation, will not follow him, because he has not sufficiently taken into account the vast difference between the visible corona with which he has been dealing and the photographic corona, which, as we have already stated, is a thing quite by itself and possessing characteristics of its own; but in any case it is very curious and interesting that not only the boundaries, but even the existence of the solar corona is again in question, and it may happen that our view of the chemical nature of the outer corona will have to be revised.

There is another matter, and one in which the American and French observers are entirely at disaccord. This, however, is of little importance, as the question raised was really settled by the photographs obtained in Egypt last year. The Americans say that in the coronal spectrum the only dark line observed was D, whereas Janssen, in his telegram to the Paris Academy, announces the discovery of the Fraunhofer spectrum and the dark lines of the solar spectrum in the corona, adding that this indicates the existence of cosmical matter round the sun. The French observation, judging from the photographic results obtained in Egypt, is much nearer the truth than the American one, but at the same time it must be acknowledged that the eye observation is one of extreme difficulty. It cannot, however, be said that the French observation is entirely accurate, for, although, no doubt, there are dark spaces in the coronal spectrum, it is not probable that all of them will correspond with the Fraunhofer lines. From the careful quantitative polariscopic observations made in 1878 in America, we know that up to a certain point the amount of reflected light increases with the height of the corona, which may be taken to mean simply that the temperature in its higher regions is so reduced that its constituents have given up their simple gaseous nature and combined to form concrete particles, which are capable of reflecting light more strongly than gases are. On the theory referred to in our previous article this is at once readily and simply explained by the supposition that a reduction of temperature enables the association of the finer molecules of matter to take place, so enabling them not only to give out light of their own, according to their special nature, but to reflect the light from the regions around them to the eye of the observer on the earth.

Note.—This article, which indicates a writer exceptionally familiar with the observations of past solar eclipses, contains several inaccuracies. Of these, the only one of great moment is the statement regarding the polarization of the coronal light. Contrary to the statement here given, the observations of Professor Wright and myself proved that the polarization decreases from the moon's limb outwards. These are the only observations to which he can refer. The fact is of great theoretical importance.

C. S. Hastings.

LIST OF WORKS IN THE LIBRARY OF THE PEABODY INSTITUTE RELATING TO ASSYRIAN, BABYLONIAN, CHALDÆAN, ETC., TEXTS AND INSCRIPTIONS.

When the information was received that Professor Haupt would join the staff of the Johns Hopkins University next autumn as Professor of the Shemitic Languages, inquiry was made at the Library of the Peabody Institute in respect to their collection of works in Assyriology and the related branches. The Librarian has been so kind as to furnish the following list, which is now published for the information of those who may wish to follow Professor Haupt in his courses at Baltimore during the ensuing year. (*See page* 129 *of Circular* 24).

Birch, S. Records of the Past. London, 1873-'81. 12 v. 12o.
Botta, P. E. Lettres sur ses découvertes à Khorsabad, près de Ninive. Paris, 1845. 8o.
Mémoire sur l'écriture cunéiforme assyrienne. (J. Asiat. 4 ser. v. 9, 10, 11.)
Découvertes à Ninive. (J. Asiat. 4 ser. v. 2, 3, 4.)
and Flandin E. Monument de Ninive. Paris, 1849-50. 5 v. l.fo.
Brandis, J. Ueber den historischen gewinn . . . der assyrischen Inschriften. Berlin, 1856. 8o.
Budge, E. A. History of Esarhaddon. London, 1880. 8o.
Burnouf, E. L. Mémoires sur deux inscriptions cunéiformes. Paris, 1836. 4o.
Sur deux inscriptions cunéiformes trouvées près d'Hamadan. (J. Asiat. 3 ser. v. 2.)
Chwolson, D. A. Ueber Tammuz u. s. w. St. Petersburg, 1860. 8o.
Coxe, W. H. Cylinder of Ilgi. (Roy. Soc. Lit. Trans. 2 ser. v. 9.)
Chossat, E. de. Classification des caractères cunéiformes babyloniens et ninivites, Paris. n. d. 4o.
Delitsch, F. Assyrische studien. Leipzig, 1874. 8o.
Eneberg, C. Inscription de Tiglath Pileser II. (J. Asiat. 7 ser. v. 6.)
Hager, J. Dissertation on the newly discovered Babylonian inscriptions. London. 1801. 4o.
Haupt, P. Die sumerischen Familiengesetze in Keilschrift. Leipzig, 1878. 4o.
Hincks, E. On the polyphony of Assyrio-Babylonian cuneiform writing. Dublin, 1863. 8o.
Layard, A. H. Inscriptions in the cuneiform characters from Assyrian Monuments, London, 1851. fo.
Discoveries in the ruins of Nineveh and Babylon. London, 1853. 8o.
Nineveh and its remains. London, 1849. 2 v. 8o.
Monuments of Nineveh. London, 1853. fo.
Lenormant, F. Les dieux de Babylone et de l'Assyrie. Paris, 1877. 8o.
La plus ancienne inscription en langue Assyrienne. (Rev. Arch. n. s. 1873. v. 25.)
Lettres assyriologiques. Paris, 1873-'74. 2 v. 4o.
Essai sur un document mathématique chaldéen. Paris, 1868. r. 8o.
Études cunéiformes. (J. Asiat. 7 ser. v. 9.)
Inscriptions cunéiformes inédites. (Rev. Arch. n. s. 1869. v. 20.)
Levy, M. A. Ueber die von Layard aufgefundenen chaldäischen Inschriften (Deutsch, Morg. Gesells. Zeits. v. 9)
Longperier, A. de. Sur les inscriptions cunéiformes de l'Assyrie. (Rev. Archéol. v. 4.)
Lottner, C. Remarks on the nation by which the cuneiform mode of writing was invented (Philol. Soc. Lond. Trans. 1858.)
Maury, A. L'inscription cunéiforme de Behistoun. (Rev. Archéol. v. 3.)
Menant, J. Exposé des éléments de la grammaire assyrienne. Paris, 1868. r. 8o.
Annales des rois d'Assyrie. Paris, 1874. 8o.
Découvertes assyriennes. Paris, 1880. 16o.
Inscriptions assyriennes. Paris, 1859. r. 8o.
Éléments d'epigraphie assyrienne. Paris, 1864. r. 8o.
Inscriptions de Hammourabi, roi de Babylone. Paris, 1863. r. 8o.
Notice sur quelques cylindres orientaux. Paris, 1878. 8o.
Mordtmann, A. D. Entzifferung der armenischen Keilinschriften von Van. (Deutsch. Morg. Gesells. Zeits. v. 26. 31.)
Ueber die Keilinschriften zweiter Gattung. (Deutsch Morg. Gesells. Zeits. v. 16. 24.)
Muenter, F. Versuch ueber die keilfoermigen Inschriften zu Persepolis. Kopenhagen, 18 2. 12o.
Norris, E. Assyrian dictionary. London, 1868-'72. 3 v. r. 8o.
Memoir on the Scythic version of the Behistun inscription. (Roy. Asiat. Soc. Jour. v. 15.)
Olshausen, J. Pruefung des charakters der in den assyrischen Keilinschriften enthaltenen semitischen Sprache. (Berlin Akad. Wissens. Abhandl. Philol., 1864.)
Oppert, J. Étalon des mesures assyriennes fixé par les textes cunéiformes. Paris. 1875. 8o.
Inscriptions assyriennes des Sargonides. Paris, n. d. 8o.
Éléments de la Grammaire assyrienne. Paris, 1868. 8o.
Études assyriennes. Paris, 1857. 8o.
Histoire des empires de Chaldée et d'Assyrie. Paris, 1870. 8o.
État actuel du dechiffrement des inscriptions cunéiformes. Paris, n. d. 8o.
Oppert, J. Expédition scientifique en Mesopotamie. v. 2.
Inscriptions cunéiformes. (Rev. Archéol. 1848.)
Les inscriptions de Dour-Sarkayan. Paris, 1870. fo.
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Pettigrew, T. J. Account of a bilingual inscription. (Archæologia, v. 31.)
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Praetorius, F. Bemerkungen zu einigen inschriften Sargons. (Deutsch. Morg. Gesells. Zeits. v. 27.)
Rawlinson, Sir H. C. Cuneiform inscriptions of Western Asia. London, 1861-'75. 4 v. l.fo. (Vol. 5, 1880, will be received next autumn.)
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Memoir on the Babylonian and Assyrian inscriptions. (Roy. Asiat. Soc. Jour. v. 14.)
On the inscriptions of Assyria and Babylonia. (Roy. Asiat. Soc. Jour. v. 12.)
Notes on paper casts of cuneiform inscriptions from Behistun. (Archæologia. v. 34.)
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Selections from historical inscriptions of Chaldea, etc. London, 1861. fo.
Saint Martin, A. J. Nouvelles observations sur les inscriptions de Persepolis. (Acad. des Inscript. Mém. v. 12. pt. 2.)
D'un mémoire relatif aux antiques inscriptions de Persepolis. (J. Asiat. 1 ser. v. 2.)
Saulcy, L. F. J. C. de. Recherches analytiques sur les inscriptions cunéiformes du système médique. Paris, 1850. 8o.
Lexique de l'inscription assyrienne de Behistoun. (J. Asiat. 5 ser. v. 5.)
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Lectures upon the Assyrian Language. London, 1877. 8o.
On the cuneiform inscriptions of Van. (Zeit. Vergl. Sprachforsch. v. 23.)
Schrader, E. Assyrisch-Babylonische Keilinschriften.
Die Assyrisch-Babylonischen Keilinschriften. Leipzig, 1872. 8o.
Kritische untersuchung der Grundlagen ihrer Entzifferung. (392 pp.) (Deutsch. Morg. Gesells. Zeits. v. 26.)
Die Basis der Entzifferung der Assyrisch-Babylonischen Keilinschriften. (Deutsch. Morg. Gesells. Zeits. v. 23.)
Keilinschriften und das Alte Testament. Giessen, 1872. 8o.
Schultz, F. E. Mémoire sur le lac de Van. (J. Asiat. 3 ser. v. 9.)
Smith, G. Assyrian discoveries. London, 1875. 8o.
Assyrian eponym canon. London. 8o.
Chaldean account of Genesis. London, 1876.
History of Assurbanipal. London, 1871. 4o.
Phonetic values of the cuneiform characters. London, 1871. 4o.
History of Sennacherib. Tr. from the cuneiform inscriptions. London, 1878. 8o.
Chaldæan account of the deluge. London, 1872. fo.
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Spiegel, F Altpersische Keilinschriften. Leipzig, 1862. 8o.
Talbot, H. F. New translation of the inscription of Bellino. (Roy. Soc. Lit. Trans. 2 ser. v. 8.)
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Comparative translations of the inscription of Tiglath Pileser I. (Roy. Asiat. Soc. Jour. v. 18.)
On the inscription of Khammurabi. (Roy. Asiat. Soc. Jour. v. 20.)
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Vaux, W. S. W. Nineveh and Persepolis. London, 1850. 8o.
Wall, C. W. On the different kinds of cuneiform writing in the triple inscriptions of the Persians. (Roy. Irish Acad. Trans. v. 21.)

See also Catalogue of the Peabody Library under Assyria, Babylonia, Chaldæa, etc.

LIST OF MODELS OF MATHEMATICAL SURFACES BELONGING TO THE JOHNS HOPKINS UNIVERSITY.

These models are of plaster, excepting Nos. 17, 25, 26, 27, 28, which are constructed of threads.

SURFACES OF THE SECOND ORDER.

1. *Right circular cone*, showing elliptic, hyperbolic, and parabolic sections (diameter of base 18 5 cm., altitude 29.5 cm).
2. *Sphere* (radius 4.5 cm.).
3. *Ellipsoid*, showing principal sections (axes $\sqrt{3} : \sqrt{2} : 1$, Major semiaxis 5 cm.).
4. " " lines of curvature (axes as in No. 3).
5. " " principal sections (axes $\sqrt{3} : \sqrt{2} : 1$, Major semiaxis 9 cm.).
6. " " lines of curvature (axes as in No. 5).
7. " " principal sections (semiaxes 6 cm., 4.15 cm., 3.05 cm.).
8. " " geodetics through two umbilics (axes $\sqrt{3} : \sqrt{2} : 1$, Major semiaxis 9.4 cm.).
9. " *of rotation* (prolate spheroid), showing geodetics (axes 3: 2: 2, semiaxis of rotation 8.75 cm.).
10. " " (prolate spheroid), showing two varieties of envelope of geodetics through a common point (axes 3 : 2 : 2, semiaxis of rotation 6 cm.).
11. " " (oblate spheroid), showing two varieties of envelope of geodetics through a common point (axes 3 : 3 : 2, semiaxis of rotation 8.5 cm.).
12. *Hyperboloid of two sheets*, showing principal sections (transverse semiaxis 2 cm., see No. 29.).
13. " *of two sheets*, showing lines of curvature (axes as in No. 12).
14. " *of one sheet with asymptotic cone*, showing principal sections (semiaxes of gorge ellipse 4 cm. and 2.1 cm., height of model 23 cm., see No. 29).
15. " *of one sheet with asymptotic cone*, showing both systems of rectilinear generators (axes as in No. 14).
16. " *of one sheet with asymptotic cone*, showing lines of curvature (axes as in No. 14).
17. " *of one sheet with asymptotic cone*, thread model showing both systems of rectilinear generators, threads stretched between two parallel elliptic sections (axes of gorge ellipse 4.2 cm. and 2.6 cm., height of model 24 cm.).
18. *Elliptic Paraboloid* bounded by section perpendicular to axis, showing principal sections (semiaxes of base ellipse 9.5 cm. and 6 cm., height of model 20 cm.).
19. " " showing elliptic sections perpendicular to axis (dimensions as in No. 18).
20. " " showing lines of curvature (dimensions as in No. 18).
21. *Hyperbolic paraboloid* (equilateral) bounded by circular cylinder about the axis showing principal sections (diameter of cylinder 14 cm.).
22. " " showing both systems of rectilinear generators (dimensions as in No. 21).
23. " " showing hyperbolic sections perpendicular to axis (dimensions as in No. 21).
24. " " showing lines of curvature (dimensions as in No. 21).
25. " " thread model showing both systems of rectilinear generators, threads stretched between two parallel parabolic sections (dimensions 28 cm., 17 cm., 20.2 cm.).
26. " " thread model showing both systems of rectilinear generators, threads stretched between opposite sides of a gauche rhombus jointed at two opposite vertices (side of rhombus 32 cm.).
27. *Circular cylinder with tangent plane*, thread model; both bases can be inclined to make elliptic cylinder, and upper base can be rotated to make hyperboloid of one sheet touched by a hyperbolic paraboloid along a common generator; shows also a ruled quartic surface with line of striction (radius of cylinder 10 cm., altitude 26 cm.).
28. *Two circular cones*, thread model showing portion of one sheet of outer cone and both sheets of inner cone, with tangent plane to outer cone; both bases can be inclined and the upper base rotated as in No. 27, in limiting position shows both systems of generators of the same hyperboloid touched by hyperbolic paraboloid (radius of upper base 10 cm., radius of lower base 20 cm., altitude of cones 22.5 cm.).
29. *Elliptic cone*, showing principal sections (semiaxes of base 10.4 cm. and 5.4 cm., altitude of cone 11.5 cm.). This is the asymptotic cone to Nos. 12-16.
30. " " showing lines of curvature (dimensions as in No. 29).
31. *Elliptic cylinder*, showing twisted cubical ellipse (semiaxes of base 4 cm. and 2.3 cm., altitude 10.5 cm.).
32. *Hyperbolic cylinder*, both sheets, showing twisted cubical hyperbola (altitude 10 cm.).
33. *Parabolic cylinder*, showing twisted cubical hyperbolic parabola (altitude 10.3 cm.).
34. " " showing twisted cubical parabola (altitude 10.3 cm.).

OTHER SURFACES.

35. *Cubic surface* with 4 real conical points, 6 real 4-fold and 3 real single straight lines, 4 real 3-fold, 6 real 2-fold and 1 other real triple tangent plane.
36. *Wave surface for optically uni-axial crystals*, one octant of outer sheet being removed (axes 8.8 : 7.8, nearly the ratio for calc-spar, dimensions 9 cm., 8 cm.).
37. *Wave surface for optically bi-axial crystals*, outer sheet removable (axes 12.2 cm., 8.3 cm., 6.2 cm.). The ellipsoid corresponding to this surface is No. 7.
38. " " *for optically bi-axial crystals*, two octants, showing ellipsoidal and spheroidal lines on both sheets (semiaxes 12 cm., 9 cm., 6 cm.).
39. *Dupin's cyclide*, ring variety (dimensions 17 cm., 17 cm. 6 cm.).
40. " " horn " (" 18.7 cm., 15.3 cm., 5.7 cm.).
41. " " spindle " (" 11.5 cm., 11.4 cm., 9.7 cm.).
42. " " parabolic " (" 15 cm., 13.5 cm., 10 cm.).
43. *Kummer's surface* (16-nodal quartic) with 16 real nodes.
44. " " " 8 " "
45. " " " 4 " "
46. *Central surface of an hyperboloid of one sheet*; two models show the two sheets of the surface separately, and a third represents the two together (axes of hyperboloid 5: 2: 1, the last being the conjugate axis.)
47. *Focal surface* of a system of rays, nearly coincident with the central surface of an elliptic paraboloid; two models show the two sheets of the surface separately, and a third represents the two together.
48. *Surface of rotation of constant positive curvature*, meridian curve meeting the axis of rotation.
49. *Surface of rotation of constant positive curvature*, meridian curve not meeting the axis of rotation.
50. *Surface of rotation of constant negative curvature*, meridian curve meeting the axis of rotation.
51. *Surface of rotation of constant negative curvature*, meridian curve not meeting the axis of rotation.
52. *Helicoidal surface of constant positive curvature*
53. " " " *negative* "
54. *Surface of rotation of constant mean curvature (unduloid)* showing geodetic lines.
55. *Surface of rotation of constant mean curvature (nodoid)*, showing geodetic lines: one model represents the surface generated by a complete period of the meridian curve, and a second represents the ring generated by the loop.
56. *Surface of rotation of constant mean curvature (catenoid)*, showing geodetic lines.
57. *Surface generated by rotating the tractrix about its asymptote*, showing geodetic lines and an asymptotic curve.
58. *Surface whose equation is* $\phi = am\,(u, k)$, ϕ, u, k being used as rectangular coordinates.
59. *Catenaries on a sphere.*
60. *Hemispherical bowl with loci of a projectile*, showing also the locus of lowest points corresponding to different horizontal velocities.

July 1, 1883.

SYNOPSIS OF THE RECENT SCIENTIFIC JOURNALS

Published here.

American Journal of Philology. Edited by Professor Gildersleeve. *Vol. IV. Whole No.* 13.

Article I.—The Color System of Vergil, by Thomas R. Price.

This paper was prepared for the Philological Association of the Johns Hopkins University, and read before that body on the 14th of April, 1882. An abstract will be found in the University Circular, No. 15, p. 205.

Article II.—Historical and Critical Remarks, introductory to a comparative study of Greek Accent, by Maurice Bloomfield.

A treatise of 42 pp., of which a résumé is given in University Circular, No. 22, p. 66.

Article III.—Etymological Studies, II, by J. P. Postgate.

Liceo and *liceor* are traced to distinct roots; *liceo* goes back to the root of *λείπειν* (intrans.) 'leave off,' *liceor* is referred with Corsson to RIK, 'reach out.' Compare *polliceri*, *licitari*, *ὀρέγεσθαι*, *digito liceri* = *χεροῖν ὀρέξασθαι*. *Trio* in *septentrio* (for **triko* **trigo* from TRAGH), is the *dragger* of the plough, the *ox*. *Sūdus* is for *surdus* (comp. *pēdo* for *πέρδω*) and is connected with *seresco*, *serenus*, *σίραιον* for *σϜίραιον*, *defrutum*. *Αὐτός* is referred to *ἄω* (*ἄϜω*), hence the 'living, breathing' man himself; though, if this is true, the consciousness was lost very early. *Βολβός* is derived from *βορ* (GAR) and means 'eatable.' The derivatives from *bulbus* (Lat.). which seems to be a borrowed word, are late and technical and even if they were not, we can see by the many derivatives of *machina* that the number of derivatives is no test of the autochthonous character of a word. *Egida*, a kind of sulphur, is derived from AGH, 'choke.' *Γοργός* is a derivative of GAR, as also *Γοργώ*; and *ὀίομαι*, *ὀίω*, are for *ὀϜίομαι* and *ὀϜίω* and connected with *οἰωνός*.

In the *Notes*, Minton Warren shows that *Gradivus* was originally *Grandivus* and that Mars Gradivus was in the beginning a god of growth; Henry Nettleship maintains that the title *bucolic caesura* was rightly given to the cadence to which Theokritos was so partial. The Greek grammarians had begun by characterizing a particular kind of *hexameter* as 'bucolic' [and] 'when the name bucolic had been attached to a hexameter of which the first word formed a dactyl and in which the fourth foot also ended a word, the phrase *bucolic caesura* may easily have been attached to the particular cadence in the fourth foot'; for J. R. Harris's 'Transposition in Seneca' see University Circular, No. 22, p. 69; 'whilst being reviewed' is cited by H. E. Shepherd from the memoirs of George Selwyn (1779).

This number contains *Reviews* of *Körting und Koschwitz's Französische Studien*; of *Vollmöller's Sammlung Französischer Neudrucke*; of *Wendelin Förster's Altfranzösische Bibliothek*, by A. M. Elliott; of *Garnett's Beowulf*, by J. A. Harrison; of *Rutherford's Babrius* and *Sturm's πρίν*, by B. L. Gildersleeve; of *Schuckburgh's Lysias*, by C. D. Morris; of *L. T. Smith's edition of Gorboduc*, by H. Wood; of *Studemund's Due Commedie Parallele di Difilo*, by Minton Warren.

The *Reports* give abstracts of *Germania Hermes*, *Zeitschrift der deutschen Morgenländischen Gesellschaft*, *Journal Asiatique*, and *Mnemosyne*.

DEGREES CONFERRED, 1883.

Doctors of Philosophy.

William J. Alexander, of Hamilton, Ontario, A. B., University of London, 1876. His principal subject has been Greek, the subsidiary, Latin. He submitted a thesis on "Participial Periphrases in Attic Prose," which will be prepared for publication in the American Journal of Philology.

William C. Day, of Baltimore, A. B., Johns Hopkins University, 1880. His principal subject has been Chemistry, the subordinate, Physics. He submitted a thesis on "The Oxidation of β-Cymenesulphamide," which will appear, in modified form, in the American Chemical Journal.

William P. Durfee, of Berkeley, California, A. B., University of Michigan, 1876. His principal subject has been Mathematics, his subordinate, Physics. He submitted a thesis on "Symmetric Functions," of which portions have already appeared in the American Journal of Mathematics.

George S. Ely, of Fredonia, N. Y., A. B., Amherst College, 1878. His principal subject was Mathematics, his subordinate, Physics. He submitted a thesis on "Bernouilli's Numbers," of which portions have already appeared in the American Journal of Mathematics.

Kakichi Mitsukuri, of Tokio, Japan, Ph. B., Yale College, 1879, who here pursued studies in Biology, and has since been called to the Professorship of Zoölogy in the University of Tokio, Japan. His thesis on "The Structure and Significance of some Aberrant Forms of Lamellibranchiate Gills," has been published in the Monthly Journal of Microscopical Science.

Bernard F. O'Connor, of Baltimore, Bach. ès Lettres, Université de France, 1874. His principal study was the Romance Languages, the subordinate, Latin. He submitted a thesis on "The Syntax of Ville-Hardouin."

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Bachelors of Arts.

William S. Bayley, of Baltimore, a graduate of the City College in 1879.
Principal Studies: Chemistry and German;—French, Mineralogy, Physics, with History, English, and Ethics.

Maurice Fels, of Philadelphia, who pursued his preliminary studies under Mr. E. Cohen.
Principal Studies: German, History, and Political Economy; — Latin, Philosophy, and Physics.

D. Sterrett Gittings, of Baltimore, who pursued his preliminary studies with Mr. H. W. Luckett.
Principal Studies: Latin and German; — Greek, French, and Chemistry.

W. Beatty Harlan, of Churchville, Maryland, a former student of St. John's College.
Principal Studies: Chemistry and Romance Languages; — Mathematics, Mineralogy, Physics, English, and Political Economy.

George T. Kemp, of Baltimore, a former student of the City College.
Principal Studies: Chemistry and German;—Physics, Biology, with History, English, and Ethics.

Gonzales Lodge, of Baltimore, a graduate of the City College in 1881.
Principal Studies: Greek and Latin; — Physics, French, and German.

William E. Stratton, of Baltimore, a former student of the City College.
Principal Studies: Biology, German, and Chemistry;—French and English.

Henry W. Williams, of Baltimore, who pursued his preliminary studies under Mr. W. S. Marston.
Principal Studies: Mathematics, German, and History;—Latin, Physics, and Logic.

Henry V. Wilson, of Baltimore, a former student of the City College.
Principal Studies: Romance Languages and German;—Physics, Chemistry, Biology, and Latin.

William J. Witzenbacher, of Hagerstown, Maryland, a former student of the Washington County High School.
Principal Studies: Mathematics and German;—Latin, French, History, and Political Economy.

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APPOINTMENTS, 1883-4.

Fellows.

William M. Arnolt, of New Brunswick, N. J., B. D., Rutgers Theological Seminary, 1882. *Greek.*

Gustav Bissing, of Baltimore, A. B., Johns Hopkins University, 1882. *Mathematics.*

Adam T. Bruce, of New York City, A. B., Princeton College, 1881. *Biology.*

Archibald L. Daniels, of Kendallville, Indiana, A. B., University of Michigan, 1876. *Mathematics.*

Ellery W. Davis, of Baltimore, S. B., University of Wisconsin, 1879. *Mathematics.*

David T. Day, of Baltimore, A. B., Johns Hopkins University, 1881. *Chemistry.*

John Dewey, of Burlington, Vt., A. B., University of Vermont, 1879. *Philosophy.*

James R. Duggan, of Macon, Ga., A. B., Mercer University, 1877; M. D., Jefferson Medical College, 1879. *Chemistry.*

William S. Fleming, of Wetumpka, Ala., A. B., Davidson College, 1878. *Greek.*

Arthur L. Frothingham, of Rome, Italy. *Shemitic Languages.*

Elgin R. L. Gould, of Oshawa, Ontario, A. B., Victoria University, 1881. *History.*

Arthur S. Hathaway, of Decatur, Mich., S. B., Cornell University, 1879. *Mathematics.*

William H. Howell, of Baltimore, A. B., Johns Hopkins University, 1881. *Biology.*

Hans C. G. von Jagemann, of Naumburg, Germany, Naumburg Gymnasium, 1876. *Modern Languages.*

Edward H. Keiser, of Allentown, Pa., S. B., Swarthmore College, 1880. *Chemistry.*

Gustav A. Liebig, Jr., of Baltimore, A. B., Johns Hopkins University, 1882. *Physics.*

C. W. Emil Miller, of Baltimore, A. B., Johns Hopkins University, 1882. *Greek.*

Charles A. Perkins, of Ware, Mass., A. B., Williams College, 1879. *Physics.*

Lewis T. Stevens, of Baltimore, A. B., Johns Hopkins University, 1882. *Biology.*

Lewis W. Wilhelm, of Baltimore, A. B., Johns Hopkins University, 1880. *History.*

Graduate Scholars.

Frank Donaldson, Jr., of Baltimore, A. B., Harvard University, 1879; M. D., University of Maryland, 1883. *Biology.*

Homer W. Hillyer, of Waupun, Wis., S. B., University of Wisconsin, 1882. *Chemistry.*

Frederic S. Lee, of Canton, N. Y., A. B., St. Lawrence University, 1878. *Biology.*

Gonzales Lodge, of Baltimore, A. B., Johns Hopkins University, 1883. *Greek.*

Albert G. Palmer, of Baltimore, A. B., Johns Hopkins University, 1882. *Chemistry.*

Ernest M. Pease, of Boulder, Col., A. B., University of Colorado, 1882. *Latin.*

B. James Ramage, of Newberry, S. C., A. B., Newberry College, 1880. *History.*

Albert H. Tolman, of Chicopee Falls, Mass., A. B., Williams College, 1877. *English.*

Arthur Yager, of Georgetown, Ky., A. B., Georgetown College (Ky), 1879. *Political Economy.*

PROCEEDINGS OF SOCIETIES.

Scientific Association

May 2.—Fiftieth regular meeting. Professor Sylvester in the chair. Thirty members present.

Papers read:

- Note on the Distribution of Heat in the Spectrum of an Incandescent Solid Body, by H. A. Rowland.
- On the Relation of Bilateral Symmetry to Function, by E. M. Hartwell. (*Abstract on p.* 149).
- Review of the Results Obtained by Fouqué and Michel Lévy, of Paris, in the Synthesis of Rocks, by G. H. Williams.

Philological Association.

May 4.—Forty-seventh regular meeting. Professor Gildersleeve in the chair. Twenty-seven members present.

Papers read:

- The Laws of Tone-Color in the English Language, by A. H. Tolman. (*Abstract on p.* 140).
- On a Plautine Pun, by M. Warren. (*Abstract on p.* 141).
- On Some Points in the Relation of the Norman Dialect to English Pronunciation, by H. C. G. Jagemann. (*Abstract on p.* 141).
- A further Note on the Stichometry of Euthalius, by J. R. Harris. (*Abstract on p.* 140).

Historical and Political Science Association,

April 6.—Dr. H. B. Adams in the chair.

Papers read:

- Topical Instruction in History, by Professor William F. Allen, of the University of Wisconsin. (*To appear in a work on Methods of Teaching History, edited by Dr. G. Stanley Hall, and published by Ginn and Heath*).
- German Methods of Writing and Teaching History. (*Letters from a University Student in Germany, read by H. B. Adams*).

April 13.—Dr. H. B. Adams in the chair.

Papers read:

- The Limits of Co-operation, by E. R. L. Gould. (*Part I. of a Monograph hereafter to be reported in the University Circulars*).
- Historical Remarks on Talbot County and the Eastern Shore, by Dr. Samuel A. Harrison, of Easton, Maryland.

April 20.—Dr. R. T. Ely in the chair.

- Customs of Land Tenure among the Boys of McDonogh Institute, Baltimore County, by John Johnson.
- Socialistic and Co-operative Features of Mormonism, by the Rev. G. D. B. Miller, of St. Mark's School, Salt Lake City.

April 27.—Dr. H. B. Adams in the chair.

Papers read:

- Machiavelli, the Founder of Modern Political Science, by Edgar Goodman.
- The Influence of John Locke upon Political Philosophy, by B. J. Ramage.

May 4.—Dr. R. T. Ely in the chair.

Papers read:

- The Office of Public Prosecutor, by F. J. Goodnow, Professor (elect) of Administrative Law in Columbia College, New York. (*Abstract on p.* 147).
- The Income Tax in the United States, by H. W. Caldwell, Instructor (elect) of History in the University of Nebraska. (*Abstract on p.* 147).

May 11.—President D. C. Gilman in the chair.

Papers read.

- Hugo Grotius, the Founder of Modern International Law, by Arthur Yager.
- Review Notices of the 300th Anniversary of the Birth of Grotius, by Dr. J. F. Jameson.
- America as a Field for Church History, by Dr. Philip Schaff, of Union Theological Seminary, New York.

May 18.—Dr. H. B. Adams in the chair.

Paper read:

- Taxation in Maryland, by C. M. Armstrong, Esq., of the Baltimore Bar.

May 25.—Dr. H. B. Adams in the chair.

Papers read:

- Taxation in Maryland, continued, by C. M. Armstrong. (*Abstract on p.* 147).
- Review of Certain Results of the United States Census of 1880, by John C. Rose, Lecturer (elect) in the University of Maryland.

May 30.—Dr. H. B. Adams in the chair.

Paper read:

- The Revised Tariff in its relation to the Economic History of the United States, by Talcott Williams, of the editorial staff of the Philadelphia Press. (*Abstract on p.* 148).

Mathematical Society.

April 18.—Professor Sylvester in the chair. Nine members present.

Papers read:

- A Remark on a Farey Series, by W. E. Story.
- Note on Binodal Quartics, by E. W. Davis. (*Abstract on p.* 144).
- A Proof of a Theorem of Jacobi, by Correspondence, by A. S. Hathaway. (*Abstract on p.* 143).
- On a Theorem in the Fundamenta Nova, by J. J. Sylvester.
- On the Intersections of Curves drawn on Quadrics, by W. E. Story.

May 16.—Professor Sylvester in the chair.

Papers read:

- On an Expression for Euler's Constant, by F. Franklin. (*Abstract on p.* 143).
- A Remark on the Intersection of Curves drawn on a given Ruled Surface, by W. E. Story. (*Abstract on p.* 143).
- On Farey Series, by J. J. Sylvester. (*Abstract on p.* 143).

Metaphysical Club.

May 8.—Thirty-first regular meeting. Dr. G. Stanley Hall in the chair. Twenty-two members present.

Papers read:

- Rhythm in the Classic Languages, by B. L. Gildersleeve.
- Wundt's Logic of Chemistry, by I. Remsen.

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